January 24, 2025

ADDENDUM #2

TO CONTRACT DOCUMENTS FOR:	Project #CP232801 Research Commons Thermal Plant Chilled Water Production Addition
ADVERTISEMENT DATE:	December 17, 2024
PREPARED FOR:	The Curators of the University of Missouri
CONSULTANT:	PRVN Consultants, Inc. 1617 Second Avenue., Suite 110 Rock Island, IL 61201 Telephone: 563.263.5160 Project: 23073

The contract documents for the above noted project and the work covered thereby and herein modified.

DOCUMENT 00 91 13–02
ADDENDUM 2

GENERAL INFORMATION:

1) BID OPENING DATE

A. The **Bid Opening Date** is being extended to **February 12, 2025,** at 1:30 pm. All other provisions of the Advertisement for Bids remain unchanged.

2) SECTION 00 92 13 – BIDDER QUESTIONS AND RESPONSES

A. **ADD** Section 00 92 13 Bidder Questions and Responses in its entirety.

PROJECT MANUAL:

3) SECTION 00 00 02 – TABLE OF CONTENTS

A. **REPLACE** Section 00 00 02 Table of Contents with 00 00 02 Table of Contents (Revision 1) in its entirety**.**

4) DOCUMENT 1.A – BID FOR LUMP SUM CONTRACT

A. Document 1.A., Bid for Lump Sum Contract: The **REVISED** "Bid for Lump Sum Contract" (Revision 1) form is attached. Revisions have been made to Article 3. Bid Pricing, Paragraph c.(6) through c.(10). **BIDS MUST BE SUBMITTED ON THE ATTACHED REVISED FORM.**

5) DOCUMENT 1.E – SPECIAL CONDITIONS

A. **REVISE** Document 1.E, Article 13 Specialties, paragraph a.(1) to read:

"(1) Contractor shall furnish and turn–over to Owner's Representative BEST seven–pin small format interchangeable core (SFIC) and key blanks. Owner will setup and install cores as well as furnish keys."

6) DOCUMENT 1.E.3 – SHOP DRAWING AND SUBMITTAL LOG

A. **REPLACE** Document 1.E.3 Shop Drawing and Submittal Log with Document 1.E.3 Shop Drawing and Submittal Log (Revision 1) in its entirety.

7) DOCUMENT 1.E.4 – OPERATING INSTRUCTIONS AND SERVICE MANUAL LOG

A. **REPLACE** Document 1.E.4 Operating Instructions and Service Manual Log with Document 1.E.4 Operating Instructions and Service Manual Log (Revision 1) in its entirety.

8) DOCUMENT 1.E.5 – CLOSEOUT LOG

A. **REPLACE** Document 1.E.5 Closeout Log with Document 1.E.5 Closeout Log (Revision 1) in its entirety.

9) DOCUMENT 1.H – ALTERNATES

A. **REPLACE** Document 1.H Alternates with Document 1.H Alternates (Revision 1) in its entirety.

10) SECTION 03 30 00 – CAST–IN–PLACE CONCRETE

A. **ADD** Section 03 30 00 Cast–In–Place Concrete, Article 2.4 Admixtures, paragraph A.7.a.iii to read:

"iii. Duraforce(v–) MRVA 900 manufactured by ISE Logik"

11) SECTION 07 41 13–16 – STANDING–SEAM METAL PANELS

A. **ADD** Section 07 41 13–16 Standing–Seam Metal Panels in its entirety.

12) SECTION 07 54 23 – THERMOPLASTIC–POLYOLEFIN (TPO) ROOFING

A. **ADD** Section 07 54 23 Thermoplastic–Polyolefin (TPO) Roofing in its entirety.

13) SECTION 07 62 00 – SHEET METAL FLASHING AND TRIM

A. **ADD** Section 07 62 00 Sheet Metal Flashing and Trim in its entirety.

14) SECTION 07 72 53 – SNOW GUARDS

A. **ADD** Section 07 72 53 Snow Guards in its entirety.

15) SECTION 07 81 00 – APPLIED FIRE PROTECTION

A. **ADD** Section 07 81 00 Applied Fire Protection in its entirety.

16) SECTION 08 35 13–13 – VERTICALLY BI–FOLD HANGAR DOOR

A. **ADD** Section 08 35 13–13 Vertically Bi–Fold Hangar Door, Article 2.2 Vertically Bi–Fold Hangar Door, paragraph A.2 to read:

"2. Midland Door Solutions
Rob Karlgaard
1021 7th St NE
West Fargo, ND 58078
Phone 701–277–8836
Fax 70–277–8961
Email: rob@midlanddoorsolutions.com "

17) SECTION 08 71 00 – DOOR HARDWARE

A. **REVISE** Section 08 71 00 Door Hardware, Article 2.9 Cylinders and Keying, paragraph A. to read:

"A. Contractor shall furnish and turn–over to Owner's Representative BEST seven–pin small format interchangeable core (SFIC) and key blanks. Owner will setup and install cores as well as furnish keys."

B. **DELETE** Section 08 71 00 Door Hardware, Set #3A, exit devices:

"~~1 Exit Device 99L–NL x 996L–NL–R&V 17 US26D VO~~"

C. **DELETE** Section 08 71 00 Door Hardware, Set #3B, exit devices:

"~~1 Exit Device 99L–NL x 996L–NL–R&V 17 US26D VO~~"

D. **DELETE** Section 08 71 00 Door Hardware, Set #4, exit devices:

"~~2 Exit Device 9927L US26D VO~~"

18) SECTION 22 10 19 – PLUMBING PIPING SPECIALTIES

A. **ADD** Section 23 65 14 Induced Draft Cooling Towers, Article 1.3 Action Submittals, paragraphs A.5 and A.6. to read:

5. "Frost Proof Hydrants:
   a. Catalog cuts showing design and construction.
   b. Pressure and temperature ratings.
   c. Materials of construction.

d. Manufacturer and model.

6. Hose Bibbs:
   a. Catalog cuts showing design and construction.
   b. Pressure and temperature ratings.
   c. Materials of construction.
   d. Manufacturer and model.”

19) SECTION 22 30 00 – PLUMBING EQUIPMENT

A. **REPLACE** Section 22 30 00 Plumbing Equipment with 22 30 00 –Plumbing Equipment (Revision 1) in its entirety.

20) SECTION 23 21 13 – PIPING FOR HVAC

A. **REVISE** Section 23 21 13 Piping for HVAC, Article 3.15 to read:

“3.15 CLEANING OF PROCESS HYDRONIC PIPING AFTER INSTALLATION

A. Contractor shall contract directly with Owner’s water treatment company, Nalco, for chemical cleaning/passivating of piping systems. Coordinate and develop cleaning, disinfection, and flushing plan with Owner’s water treatment company.

B. Cleaning and flushing of individual piping systems shall occur within 24 hours of completing hydrostatic pressure testing of that system. Cleaning and flushing of piping shall not occur until hydrostatic pressure tests have been successfully concluded.

C. Submit cleaning and flushing plan for each system no later than 72 hours before commencement of hydrostatic pressure testing. Plan shall include identification of flow path, equipment status, fill connection point, drain connection point, and valve positions.

D. Construction phasing will require the Contractor to conduct flushing and cleaning of piping as each phase and associated work is complete.

E. Contractor shall fill each piping system using the plant process water system at the fill connection point. Record the amount of water (gallons) added to fill the system.

F. Provide all equipment, including but not limited to pumps, fittings, blind flanges, plugs, temporary piping, valves, hoses, instrumentation, shot feeder, backflow preventer, water meter, and specialties not shown on Drawings but necessary for completion of flushing, cleaning, draining, and treating of hydronic piping systems. Each shall be rated for the design pressure of the system being flushed and cleaned.

G. Flushing procedure:
   1. Install temporary conical (witch hat) type strainer at the suction of each new hydronic pump or chiller. If existing hydronic system will be included in flushing procedures, provide temporary strainer at the suction of each existing hydronic pump or chiller.
   2. Flush all piping sufficiently to remove all dirt and debris. Velocity shall be equivalent to that experienced during normal plant operation at maximum loads. During flushing, all equipment, control valves, instruments, and specialties subject to damage from flushing must be disconnected or isolated from the system.
   3. Periodically check temporary conical strainers for debris and repeat flushing until strainer is clear of construction debris, welding slag, etc.

H. Cleaning procedure:
1. Cleaning chemicals shall be provided by Owner's water treatment company.
2. Provide and utilize a chemical shot bypass feeder to introduce chemicals into hydronic systems.
3. Chemicals shall be pre–mixed prior to introduction to the piping system.
4. Chemicals shall circulate for not less than 48 hours using circulation method specified in the Hydronic Piping Flushing and Cleaning Schedule below.
5. Following cleaning chemical circulation, use process water to flush chemicals until cleaning solution has been removed from hydronic system. Owner will sample the waste stream.
6. After cleaning is complete, remove, clean, and replace all strainer baskets and elements. Reconnect all equipment and demolish temporary piping, fittings, instrumentation, and specialties. Provide safe points of discharge for debris blown from pipes.

I. Treatment procedure:
1. Following flushing of cleaning chemicals, Contractor shall completely fill hydronic piping system from the bottom up. Filling shall be slow, taking care to remove air from extremities and high points.
2. Contractor shall provide and introduce corrosion inhibitor and other treatment chemicals for each hydronic system.
3. Coordinate with Owner's Representative for chemicals including quantities to be used for each chemical treatment program.

J. Hydronic piping flushing and cleaning schedule:

Hydronic System	Include Existing System	Flushing	Cleaning	Chemical Treatment	Circulation Method
Chilled Water Supply and Return		X	X	X	Chiller and Loop pumps
Tower Water Supply and Return		X	X	X	Tower pumps
RO Flush		X	X	X	Contractor provided pump
Soft Water		X	X	X	Contractor provided pump

21) SECTION 23 21 23 – HYDRONIC PUMPS

A. **DELETE** Section 23 21 23 Hydronic Pumps, Article 1.5 Quality Assurance, paragraph G:

"~~G. If the pump impeller requires trimming after performance test to provide the specified flow and head, then the impeller must be rebalanced to the specified tolerance.~~

B. **REVISE** Section 23 21 23 Hydronic Pumps, Article 2.2 Vertical In–Line Pumps, paragraph I.2.b to read:

"b. Enclosure: Totally–Enclosed, Fan Cooled (TEFC) shall be an IEEE 841 motor."

C. **REVISE** Section 23 21 23 Hydronic Pumps, Article 2.2 Vertical In–Line Pumps, paragraph D.3 to read:

"3. Impeller shall meet specified design operating conditions per Hydraulic Institute."

D. **REVISE** Section 23 21 23 Hydronic Pumps**,** Article 3.3 to read:

"3.3 STARTUP SERVICE

A. Engage a factory–authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Perform the following startup checks for each pump before starting:
   a. Verify bearing lubrication.
   b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
   c. Verify that pump is rotating in the correct direction.
5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
6. Start motor.
7. Open discharge valve slowly."

E. **REVISE** Section 23 21 23 Hydronic Pumps, Article 3.4 to read:

"3.4 DEMONSTRATION

A. Engage a factory–authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps."

22) SECTION 23 65 14 – INDUCED DRAFT COOLING TOWERS

A. **REVISE** Section 23 65 14 Induced Draft Cooling Towers, Article 1.1 Summary, paragraph A.11. to read:

"11. Access and safety appurtenances, including ladders, access doors, etc."

B. **REVISE** Section 23 65 14 Induced Draft Cooling Towers, Article 1.6 Delivery, Storage, and Handling, paragraph A.11. to read:

"11. Access and safety appurtenances, including ladders, access doors, etc."

C. **REVISE** Section 23 65 14 Induced Draft Cooling Towers, Article 2.5 Mechanical Equipment, paragraph C.1. to read:

"1. Power shall be transmitted from the motor to the speed reducer by means of a dynamically balanced stainless-steel tube with flanged connections."

D. **REVISE** Section 23 65 14 Induced Draft Cooling Towers, Article 3.7 Performance Testing to read:

"3.7 PERFORMANCE TESTING

A. CTI Certification notwithstanding, the cooling tower manufacturer shall guarantee that the tower supplied will meet the specified performance conditions when the tower is installed according to plan. If, because of a suspected thermal performance deficiency, the Owner chooses to conduct an on–site thermal performance test under the supervision of a qualified, disinterested third party in accordance with CTI or ASME standards during the first year of operation; and if the tower fails to perform within the limits of test tolerance; then the cooling tower manufacturer will pay for the cost of the test and will make such corrections as are appropriate and agreeable to the Owner to compensate for the performance deficiency."

23) SECTION 26 29 23 – VARIABLE FREQUENCY MOTOR CONTROLLERS

A. **DELETE** Section 23 29 23 Variable Frequency Motor Controllers, Article 2.2 Variable–Frequency Controller, paragraph A.1:

"~~1. Lockable input power circuit breaker disconnect rated for 65,000 amperes interrupting symmetrical current.~~"

24) SECTION 40 90 00 – PROCESS AUTOMATION CONTROL SYSTEM

A. **REVISE** Section 40 90 00 Process Automation Control System, Article 2.2 Pressure Indicating Transmitter, Gauge, paragraph B.11. to read:

"11. Indicator: Local Display."

B. **DELETE** Section 40 90 00 Process Automation Control System, Article 2.13 Control Valve, Double Offset Butterly with Electric Actuator (Open – Closed), paragraph A.1.c. to read:

"~~c. 00–FCV–088E – RCP Chilled Water Makeup Emergency – Process Water Control (4" Ball).~~"

C. **REVISE** Section 40 90 00 Process Automation Control System, Article 2.13 Control Valve, Double Offset Butterly with Electric Actuator (Open – Closed), paragraph B.1. to read:

"1. Service: Open–close."

D. **ADD** Section 40 90 00 Process Automation Control System, Article 2.14 Control Valve, Double Offset Butterly with Electric Actuator (Continuous Modulating), paragraph A.1.e. to read:

"~~c. 00–FCV–088E – RCP Chilled Water Makeup Emergency – Process Water Control (4" Ball).~~"

25) EXHIBIT D – STORMWATER POLLUTION PREVENTION PLAN

A. **REPLACE** Document Stormwater Pollution Prevention Plan (SWPPP) (Revision 1) in its entirety.

26) EXHIBIT F RCTP –SEGMENTED BLOCK RETAINING WALL

A. **ADD** Exhibit F RCTP – Segmented Block Retaining Wall in its entirety.

DRAWINGS:

27) The following Drawings have been revised, as indicated by revision number, and are **REISSUED** herewith:

Drawing No.	Title	Rev. No.
G–002	General Legend And Notes	1
GA–100	General Arrangement Plan – Site	1
C–001	General Notes	1
C–200	Site Plan	1
C–400	Utility Profiles	1
C–401	Utility Profiles	1
S–200	Foundation Plan	1
S–210	Foundation Details	1
S–300	Utility Platform Framing Plan	1
S–413	Roof Framing Details	1
S–700	Building Elevations	1
S–701	Building Elevations	1
S–702	Building Elevations	1
A–410	Wall Sections	1
A–501	Details	1
A–503	Details	1
A–600	Schedules	1
P–132	Plumbing Plan – Operating Floor	1
P–152	Plumbing Plan – Lower Roof	1
P–621	Plumbing Schedules	1

M–602	Piping And Instrumentation Diagram – Chilled Water – Sheet 2	1
M–611	Piping And Instrumentation Diagram – Tower Water – Sheet 1	1
M–612	Piping And Instrumentation Diagram – Tower Water – Sheet 2	1
M–631	Piping And Instrumentation Diagram – Tower Water Treatment	1
M–632	Piping And Instrumentation Diagram – Chilled Water Treatment	1
MP–132	Mechanical Piping Plan – Operating Floor	1
MP–142	Mechanical Piping Plan – Equipment Platform	1
MP–152	Mechanical Piping Plan – Lower Roof	1
MP–162	Mechanical Piping Plan – Upper Roof	1
MP–221	Mechanical Piping Sections – Sheet 1	1
MP–222	Mechanical Piping Sections – Sheet 2	1
MP–223	Mechanical Piping Sections – Sheet 3	1
MP–224	Mechanical Piping Sections – Sheet 4	1
MP–226	Mechanical Piping Sections – Sheet 6	1
MP–227	Mechanical Piping Sections – Sheet 7	1
MP–621	Mechanical Schedules – Sheet 1	1
MP–622	Mechanical Schedules – Sheet 2	1
MH–132	Mechanical HVAC Plan – Operating Floor	1
MH–142	Mechanical HVAC Plan – Equipment Platform	1
MH–221	Mechanical HVAC Sections – Sheet 1	1
MH–222	Mechanical HVAC Sections – Sheet 2	1
MS–132	Mechanical Support Plan – Operating Floor	1
MS–142	Mechanical Support Plan – Equipment Platform	1
MS–152	Mechanical Support Plan – Lower Roof	1
MS–621	Mechanical Support Schedules – Sheet 1	1
MI–142	Instrument Plan – Equipment Platform	1
EO–012	Electrical One–Line Diagram	1
EG–132	Electrical Grounding Plan – Operating Floor	1
EG–162	Electrical Grounding Plan – Upper Roof	1
EP–122	Electrical Power Plan – Utility Pit	1
EP–132	Electrical Power Plan – Operating Floor	1
EP–142	Electrical Power Plan – Equipment Platform	1
EP–152	Electrical Power Plan – Lower Roof	1
EP–162	Electrical Power Plan – Upper Roof	1
EP–221	Electrical Sections – Sheet 1	1
EP–505	Electrical Power Details – Sheet 5 – Heat Trace	1
EP–602	Electrical Power Schedules – Distribution Panels	1
EP–611	Electrical Power Cable Schedules	1
EP–612	Electrical Control Cable Schedules	1
EP–613	Electrical Instrumentation Cable Schedules	1
EL–132	Electrical Lighting Plan – Operating Floor	1
EL–142	Electrical Lighting Plan – Equipment Platform	1
EL–162	Electrical Lighting Plan – Upper Roof	1
EH–501	Electrical HVAC Details – BAS	1
EI–132	Electrical Security Plan – Operating Floor	1
EI–162	Electrical Security Plan – Upper Roof	1
EC–011	Chiller System EMCS Network Diagram	1
EC–601	Electrical Controls Schedules – I/O List	1

END OF ADDENDUM

I hereby certify that these Specifications have been prepared by me, or under my supervision. I further certify that to the best of my knowledge these Specifications are as required by and in compliance with Building Codes of the University of Missouri.

Addendum 2 Specification Sections:

26 29 23
40 90 00

ENGINEER OF RECORD
JEFFERY GAMBRALL
LICENSE NO. PE-2000178300
PRVN CONSULTANTS, INC.
1617 SECOND AVE., SUITE 110
ROCK ISLAND, IL 61201
TELEPHONE: 563.263.5160
CORPORATE CERTIFICATE OF AUTHORITY
NO. 202301760

I hereby certify that these Specifications have been prepared by me, or under my supervision. I further certify that to the best of my knowledge these Specifications are as required by and in compliance with Building Codes of the University of Missouri.

Addendum 2 Specification Sections:

22 10 19
22 30 00
23 21 13
23 21 23
23 65 14

ENGINEER OF RECORD
JAMES J NONNENMANN
LICENSE NO. PE-5053025612
PRVN CONSULTANTS, INC.
1617 SECOND AVE., SUITE 110
ROCK ISLAND, IL 61201
TELEPHONE: 563.263.5160
CORPORATE CERTIFICATE OF AUTHORITY
NO. 2023017605

I hereby certify that these Specifications have been prepared by me, or under my supervision. I further certify that to the best of my knowledge these Specifications are as required by and in compliance with Building Codes of the University of Missouri.

Addendum 2 Specifications Sections:

07 41 13-16
07 54 23
07 62 00
07 72 53
07 81 00
08 35 13-13
08 71 00

ARCHITECT OF RECORD
NATHAN KENT BOEN
LICENSE NO. PE-2000178300
POWELL CWM, INC.
3200 S. STATE ROUTE 291, BUILDING 1
INDEPENDENCE, MO 64057
TELEPHONE: 816.373.4800
CORPORATE CERTIFICATE OF AUTHORITY
NO. 000310

I hereby certify that these Specifications have been prepared by me, or under my supervision. I further certify that to the best of my knowledge these Specifications are as required by and in compliance with Building Codes of the University of Missouri.

Addendum 2 Specification Sections:

03 30 00

ENGINEER OF RECORD
GREGORY L. LINNEMAN
LICENSE NO. 2005001013
CROCKETT ENGINEERING CONSULTANTS
1000 W. NIFONG BOULEVARD, BUILDING 1
COLUMBIA, MO 65203
TELEPHONE: 573.447.0292
CORPORATE CERTIFICATE OF AUTHORITY
NO. 2000151301

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DOCUMENT 00 92 13-02
BIDDER QUESTIONS AND ANSWERS

Num	Reference	Bidder Question	Design Professional Response
1	Contract	**Start date:** When is the anticipated start of construction?	Construction is anticipated to begin 3 weeks after Notice to Proceed.
2	Contract	**Substantial Complete for Project CP200001:** Substantial completion for first building?	Likely February 2025, might be startup and commissioning extending into march, should not interfere with parking or beginning of work.
3	Contract	**Tax Emption:** Please confirm this project is tax exempt.	Confirmed.
4	Contract	**Liquidated Damages:** Are there liquidated damages on this project?	No there are not.
5	1.A	**Drilled Piers:** Varying bedrock - Will there be an allotment on lean concrete to bedrock?	Unit pricing for lean concrete to bedrock has been added to Document 1.A Bid for Lump Sum Contract. (Addendum 2)
6	03 30 00	**Cast-In-Place Concrete** Request admixture substitution of Duraforce(v-) MRVA 900 manufactured by ISE Logik for concrete admixture.	Duraforce(v-) MRVA 900 manufactured by ISE Logik is acceptable. (Addendum 2)
7	05 12 00	**Structural Steel Framing:** Can you confirm that the only steel galvanized is the screen wall and the cooling tower alternate? I assume the steel under the grating is painted.	Correct.
8	05 12 13	**Architecturally Exposed Structural Steel Framing:** There is an AESS specification, but I don't see anything that is shown as AESS. Can you confirm that there isn't any AESS steel?	This specification covers railing and stairs, but these are fairly utilitarian, not especially architectural.
9	07 41 13-16	**Standing Seam Metal Panels:** Can we get a standing seam metal roof spec added to this project?	Section 07 41 13-16 Standing Seam Metal Panels will be issued. (Addendum 2)
10	07 54 23	**Thermoplastic-Polyolefin (TPO) Roofing:** Do you perform waterproofing in house and/or have a concrete contractor that does this?	Concrete contractor.
11	07 54 23	**Thermoplastic-Polyolefin (TPO) Roofing:** We can install Cetco, Drainage Mat, and Insulation (potentially pending on what they want)	Will need TPO with drainage mat and insulation. (Addendum 2)
12	07 54 23	**Thermoplastic-Polyolefin (TPO) Roofing:** No Insulation Spec? Drawings shows 5" Start with 1/8" tapered under the 3" concrete Slab.	TPO spec added with extruded polystyrene board spec. (Addendum 2)
13	07 54 23	**Thermoplastic-Polyolefin (TPO) Roofing:** I'd imagine they want PVC Waterproofing to come up above the concrete slab. Can we switch the walls to PVC in lieu of TPO, so we can weld to the PVC waterproofing with new PVC roof membrane flashings up to the wall panel receiver?	Use TPO to match updated roof spec. (Addendum 2)
14	07 54 23	**Thermoplastic-Polyolefin (TPO) Roofing:** Also, assuming the Sheet Metal guys will install a vapor barrier up the remainder of the walls for the interior sides of the wall panels?	Correct.
15	07 54 23	**Thermoplastic-Polyolefin (TPO) Roofing:** Cetco is a little special with their warranties. Are we looking for a full system warranty where they will carry the burden? Full NDL Warranty?	TPO spec has been added and Cetco will not be used. Will need fully system warranty for TPO product. (Addendum 2)
16	07 54 23	**Thermoplastic-Polyolefin (TPO) Roofing**: Will there be a 3rd party inspector to complete the testing for this, or do we need to carry this with Cetco?	3rd Party to complete
17	07 54 23	**Roof Stair Tower:** Can we switch this to PVC roof membrane, and then we can use the same product on the stair tower roof as the walls exposed on the Chiller Roof? No Roofing Spec?	TPO will be used. (Addendum 2)

Num	Reference	Bidder Question	Design Professional Response
18	07 54 23	**Thermoplastic-Polyolefin (TPO) Roofing:** The drawings mention TPO Roofing membrane put the specifications call out PVC membrane please clarify which one you want us to use on the stair tower roof.	TPO will be used. (Addendum 2)
19	07 54 23	**Thermoplastic-Polyolefin (TPO) Roofing:** Can the design team provide a specification of what type of 5" rigid insulation they want us to install under the topping slab. Nothing is specified.	Specified in TPO spec. (Addendum 2)
20	07 54 23	**Thermoplastic-Polyolefin (TPO) Roofing:** Can the design team provide a specification for the type of insulation they want on the stair tower roof section?	Specified in TPO spec and updated in drawings. (Addendum 2)
21	07 62 00	**Sheet Metal Flashing and Trim**: Can we get a sheet metal flashing spec added to this project?	Metal flashing spec provided. (Addendum 2)
22	07 81 00	**Applied Fire Protection:** Please provide a spec for the spray applied fireproofing.	Fire proofing spec provided. (Addendum 2)
23	08 35 13-13	**Vertically Bi-Fold Hangar Door:** Request substitution of Midland Door Solutions for vertically bi-fold hangar door.	Midland Door Solutions for vertically bi-fold hangar door is acceptable. (Addendum 2)
24	08 71 00	**Door Hardware:** Hardware sets 3A, 3B and 4 have exit devices and cylindrical locks called out. Which is required for each set?	Exit devices will be deleted from specifications. (Addendum 2)
25	21 22 00	**Clean Agent Fire-Extinguishing Systems:** 2.1 D. indicates that a 7% concentration is desired, this should be 4.5% as required for a Class C fire. Also, indicate what Class of fire is to be protected (A, B or C). we assume this is a Class C hazard.	D-1 prohibits concentrations higher than 7 % and requires a 5.2 % which would match the recommended concentration provided in the adjacent rooms previous installation.
26	21 22 00	**Clean Agent Fire-Extinguishing Systems:** 2.6 A.1. 3M no longer manufacturers FK-5-1-12.	Understood – this is still viable if the supplier has it on the shelf – No change required. Note: this statement does not limit the supply to 3M
27	21 22 00	**Clean Agent Fire-Extinguishing Systems:** 2.8 D. Control Panels, please clarify is an addressable or conventional control system is desired.	Addressable.
28	21 22 00	**Clean Agent Fire-Extinguishing Systems:** 2.8 F. indicates that a graphic type annunciator is required, all the smoke detectors are visible, there are no hidden detectors	Correct.
29	21 22 00	**Clean Agent Fire-Extinguishing Systems:** 2.11 A.2. Refers to a key operated main-to-reserve transfer switch. Is a reserve supply of agent required? A reserve cylinder is not mentioned on the drawings.	A reserve cylinder is not required.
30	23 09 00	**Building Automation System**: Is the instrumentation and controls vendor to be sole sourced?	The Contractor shall provide field instruments, control valves, and damper actuator as well as raceways and cables. The Owner will furnish the Building Automation System control panel for Contractor installation. The Owner will provide control system hardware and programming.
31	23 25 26	**Sand Filter System:** Who will be attaining pricing for the sand filtration, mech contractor?	The Contractor is to provide the sand filter system refer to requirements in Section 23 25 26
32	23 65 14	**Induced Draft Cooling Towers:** Are there any details or specs on the jib cranes?	Cooling tower davit cranes are designed and provided by the cooling tower manufacturer. These are included in the 23 65 14 specification section.
33	23 65 14	**Induced Draft Cooling Towers:** The specs indicate that the cooling tower manufacturer is to provide the steps and work platform shown on A 506 (Spec 23 65 14-1 A11).	Cooling tower stairs for accessing the cooling tower will not be by the cooling tower supplier. References to stairs will be removed from Section 23 65 14 Induced Draft Cooling Towers. (Addendum 2)

Num	Reference	Bidder Question	Design Professional Response
34	40 90 00	**Process Control System:** Is the instrumentation and controls vendor to be sole sourced?	The Contractor shall provide field instruments, control valves, and damper actuator as well as raceways and cables. The Owner will furnish the Process Automation Control System control panel for Contractor installation. The Owner will provide control system hardware and programming.
35	G-000	**Delegated Designs:** Is there a table summarizing what is delegated?	The Contractor shall contract with Professional Engineers for the specialty system designs shown as delegated in the table on the lower right-hand side of Drawing G-000.
36	G-000	**3D Model:** Is a 3D model available for Contractor use?	The Design Professional will make available the 3D model to the successful Contractor. However, the Contractual project requirements are shown on the Bid Documents including Addendums. The model will be furnished for convenience and shall not change the Contract requirements.
37	G-000	**Job Trailer:** Where is the proposed location for a job trailer?	The job tailer location has been shown on Drawing G-000. The space is to the east of the existing Research Commons Thermal Plant.
38	G-100	**Laydown Space Notes:** Where is the project laydown space shown?	The project laydown space is identified on Drawing G-100. The primary space will be the area along Carrie Francke Drive to the west of the Project Site. If additional space is needed, the parking lot east of the plant will be used, at the discretion of the University's Construction Manager. This lot is heavily used for football tailgating and other purposes. All laydown space utilized during the project shall be returned to pre-construction conditions at the conclusion of the project. Refer to notes on Drawing GA-100 for laydown space requirements. (Addendum 2)
39	G-100	**Laydown Space Notes:** The laydown area for the project will need to be cleared and fenced. If we gravel the area, will we need to return it to original state, or can it gravel stay in place?	Gravel will need to be removed, and the site will need to final graded. Laydown areas in planted areas shall be covered with geotextile fabric and 4” of gravel. Remove gravel and fabric when laydown area is vacated. Refer to notes on Drawing GA-100 for laydown space requirements. (Addendum 2)
40	GA-132	**Acid and bleach tanks:** Who is responsible for furnishing the acid and bleach tanks?	The Contractor shall provide the acid and bleach tanks.
41	C-100	**Site Conditions:** In the location of the new proposed building, is there any stripping of topsoil anticipated?	The CP200001 Contractor, currently constructing the Research Common Thermal Plant, will not be performing any grading to the west of the facility. They will remove their job trailers, materials, dumpsters, etc. And leave the grade in its current state.
42	C-300	**Topsoil:** In the location of the new proposed building, Is there any stripping of topsoil anticipated? Will the contractor building the thermal plant currently be placing topsoil and seeding/mulching the area we are bidding?	Contractor shall leave the area disrupted by the project 6" below the final elevation for topsoil & seeding by MU Landscape Services.
43	C-300	**Gravel:** What is the depth of the gravel pavement on the north side of the building?	The depth of the gravel pavement shall be 6 inches with geotextile fabric underneath and compacted subgrade.

Num	Reference	Bidder Question	Design Professional Response
44	C-302	**Retaining wall:** Delegated design to match the existing, does it need to be delegated if the existing has also been designated?	Furnished delegated design which will account for actual soil conditions in the area of the retaining wall. However, the intent is to match what is there. Exhibit F will be added to the Contract by Addendum 2 which will include the submittal documents for the Existing shop drawings can be added as an exhibit.
45	C-400	**Storm Manhole:** Can you confirm there is only (1) storm manhole?	The Contractor is to provide one new concrete manhole for the project. The other storm structures are specified to be ADS Nylopast as shown in the profile. (Addendum 2)
46	C-400	**Sanitary Sewer:** What is the purpose of 8" PVC from SSM-505 to SSM-506?	The purpose of the 8" PVC is to avoid sewer conflicts with proposed storm.
47	C-400	**Sanitary Sewer:** Looks like SSM506 & SSM505 are existing manholes?	Correct, MH SSM505 will need to be modified with the lowering of the existing sewer line. (Addendum 2)
48	C-504	**Stormwater:** Is there any underdrain/pipe work associated with the rain garden expansion?	The underdrains will be extended to the new rain garden limits and cleanouts relocated as necessary.
49	S-100	**Seismic:** Is this seismic per code, or per MU seismic by code?	The seismic requirements for the project are per the International Building Code (IBC) as shown on Drawing S-100.
50	S-100	**Structural Steel Painting:** Can you confirm that we can provide one coat of our standard shop primer per the specifications, in lieu of, the "Ironclad Retardo Rust Inhibitive Paint 163" as stated in note 6 under the structural steel section on S100?	Standard shop primer would be sufficient.
51	S-200	**Drilled Piers:** The main piers are shown on schedule. Are dimensions listed within the schedule applicable to the intermediary piers or just main?	Borings were taken at each column location. Bidders will need to interpolate to determine lengths of the intermediate piers. (Addendum 2)
52	S-200	**Drilled Piers:** Attached is a marked up S200 of the MU Thermal Plant addition. My question being, the 1'-6" piers that are highlighted are not included in the pier schedule, Are the Unit prices on the bid document related to the 18" piers or are they related to the pier schedule on S210? Also, should there be a lean concrete unit price related to note 8 on page S200?	The quantities in Document 1.A Bid for Lump Sum Contract, unit cost portion are close approximations of the total pier lengths required for the project utilized to establish unit costs associated with building the project. However, the Contractor is responsible for their own take-off quantities for the project. The structural drawings and geotechnical report provide approximate top of rock elevators to be used for contractor drilled pier take-off quantities. (Addendum 2)
53	S-413	**Boiler Stack:** Can you provide the locations, or the quantity of guywire supports per S413?	The expectation is that there will be three guywires. These will be located on the adjacent PEMB to support a new exhaust stack, exact location will need to be coordinated in the field. (Addendum 2)
54	A-410	**Wall Insulation:** 2nd floor exterior wall insulation. Is it the intent for the insulated metal wall panels to act as the only insulation above the masonry walls as detailed on A 410?	Correct.
55	A-410	**Roof Membrane:** 1/A410 Wall detail shows roofing membrane up and over the top of the membrane what flashing materials are you wanting?	Drawings have been updated to show TPO membrane running up wall to termination bar and transitioning into metal panels up to coping. (Addendum 2)
56	A-410	**Waterproofing System:** Architectural Drawings – 4/410 – Call out roof membrane, fully adhered, R30, then concrete slab? Do they want a waterproofing system or a roof system?	Roof consists of metal panel/concrete layer under TPO membrane with sloped insulation covered with concrete top layer. This will be coated with Tremco waterproofing. (Addendum 2)
57	A-501	**Roof Membrane:** The drawings mention TPO Roofing membrane put the specifications call out PVC membrane please clarify which one you want us to use on the stair tower roof.	TPO, spec provided.

Num	Reference	Bidder Question	Design Professional Response
58	A-501	**Roof Membrane:** Details 9/A501 call out for Tremco wall flashing membrane to be installed up the parapet walls. However, detail 7/A501 calls out for TPO flashing. Can you please clarify what walls receive what type of membrane/waterproofing.	Details have been updated. TPO will run up walls to metal panel transition. TREMCO is only for concrete surface. (Addendum 2)
59	A-501	**Waterproofing System:** Wall flashing details show waterproofing stopping at the base of the walls and then starting with the PUMA Coating on some details such as 9/A501 and 12/A501, but to get there you look at 1/A401 and it states TPO wall flashings. Does the Architect want TPO Roof system under the concrete? Will they accept a PVC roof system?	Roof consists of metal panel/concrete layer under TPO membrane with sloped insulation covered with concrete top layer. This will be coated with Tremco waterproofing. Details have been updated. TPO will run up walls to metal panel transition. TREMCO is only for concrete surface. (Addendum 2)
60	A-504	**Fireproofing:** It appears the fireproofing is limited to just the steel in the chemical storage area. Please confirm this is the extent of the scope	Correct, spec provided.
61	A-504	**Fireproofing:** I am looking for some clarification for the fireproofing scope. On A-504 it shows fireproofing in the chemical storage area is this the only area that is receiving Fireproofing. Also, I would need to know the hourly rating we need to achieve. This project comes up as IIB construction which technically means it is unprotected.	Chemical storage is only fire rated room, and is called out as a 2-hour wall fire rating per A-110.
62	A-506	**Cooling Tower Stairs:** The specs indicate that the cooling tower manufacturer is to provide the steps and work platform shown on A 506 (Spec 23 65 14-1 A11). If not please provide steel details for the cooling tower stairs and work platforms.	Cooling tower stairs will not be furnished by cooling tower supplier. Refer to Drawing A-506 for details for stairs including platforms.
63	A-600	**Epoxy Floor Coating:** On A-600, all the rooms listed with a sealed concrete floor finish have a note for epoxy floor coating during construction. Please advise what the floor finish is to be	Floor finishes have been updated to show Resinous flooring per spec to match existing building. (Addendum 2)
64	A-600	**Epoxy Floor Coating:** If the flooring is epoxy what is the height of cove	4” cove base. (Addendum 2)
65	FX-130	**Clean Agent Fire Suppression System:** General, the specifications do not mention door fan testing, we assume that a door fan room integrity test is required. The responsibility for room integrity should be mentioned as belonging to the General Contractor constructing the enclosures with guidance from the clean agent system provider.	Refer to drawings FX-130 Clean Agent Notes # 8 and corresponding Room venting Note.
66	MP-622	**Jib Crane:** Are there any details or specs on the jib crane?	Please refer to the hoist and trolley schedule on page MP-622 for the basis of design for the trolleys, cantilevered wall crane (roof), and electric hoists. (Addendum 2)
67	EL132	**Lighting:** Furnish details of the reflected ceiling plan referenced in lighting drawings	A reflected ceiling is not required and is no references to such can be found on the lighting drawings.
68	EI-501	**Access Control:** Is the card reader Owner provided?	Note 8 on Drawing EI-501 indicates that the card reader is provided by the Owner. The Contractor to provide conduit, cable, and junction box at location indicated.

END OF ADDENDUM

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SECTION 1.A

BID FOR LUMP SUM CONTRACT
ADDENDUM 2

Date:_____

BID OF _____

(hereinafter called "Bidder") a corporation* organized and existing under laws of the State of _____,

a partnership* consisting of _____,

an individual* trading as _____,

a joint venture* consisting of _____

_____.

*Insert Corporation(s), partnership or individual, as applicable.

TO: Curators of the University of Missouri
c/o Associate Vice Chancellor – Facilities
Room L100, General Services Building
University of Missouri
Columbia, Missouri 65211

1. Bidder, in compliance with invitation for bids for construction work in accordance with Drawings and Specifications prepared by PRVN Consultants, Inc., entitled Research Commons Thermal Plant – Chilled Water Production Addition, project number CP232801, dated December 5, 2024 having examined Contract Documents and site of proposed work, and being familiar with all conditions pertaining to construction of proposed project, including availability of materials and labor, hereby proposes to furnish all labor, materials and supplies to construct project in accordance with Contract Documents, within time set forth herein at prices stated below. Prices shall cover all expenses, including taxes not covered by the University of Missouri's tax exemption status, incurred in performing work required under Contract documents, of which this Bid is a part.

   Bidder acknowledges receipt of following addenda:

   Addendum No. _____Dated _____

   Addendum No. _____Dated _____

   Addendum No. _____Dated _____

   Addendum No. _____Dated _____

2. In following Bid(s), amount(s) shall be written in both words and figures. In case of discrepancy between words and figures, words shall govern.

3. BID PRICING

   a. **Base Bid**:

      The Bidder agrees to furnish all labor, materials, tools, and equipment required to provide a chilled water production expansion of the Research Commons Thermal Plant; all as indicated on the Drawings and described in these Specifications for sum of:

      _____

      _____DOLLARS ($_____).

   b. Additive Alternate Bids:

      Above Base Bid may be changed in accordance with the following Alternate Bids as Owner may elect. Alternates are as described in Section 1.H of the Project Manual. Alternates are written in a priority order, but Owner is not required to accept or reject in order listed. This is a one (1) contract project, therefore, Alternates shall be studied by each Bidder to determine effect on Bids of Contractor and each Subcontractor and/or Material supplier.

(1) **Additive Alternate No. 1 Loop Pump LP-02:**

Loop Pump LP-02 including chilled water loop pump, piping, fittings, valves, insulation, variable frequency drives, instrumentation, control devices, and electrical cabling and raceways. All for the sum of:

_____

_____DOLLARS ($ _____).

(2) **Additive Alternate No. 2 Cooling Tower CT-02 and Tower Pump TP-02:**

Cooling Tower CT-02 including cooling tower, tower water pump, piping, fittings, valves, insulation, variable frequency drive, instrumentation, control devices, and electrical cabling and raceways. All for the sum of:

_____

_____DOLLARS ($ _____).

(3) **Additive Alternate No. 3 Chiller CH-02 and Chiller Pump CP-02:**

Chiller CH-02 and Chiller Pump CP-02 including chiller installation, chiller pump, piping, fittings, valves, insulation, variable frequency drives, instrumentation, control devices, and electrical cabling and raceways. All for the sum of:

_____

_____DOLLARS ($ _____).

c. Unit Prices:

(1) For changing specified quantities of work from those indicated by Contract Drawings and Specifications, upon written instructions of Owner, the following Unit Prices shall prevail in accordance with General Conditions.

(2) The following Unit Prices include all labor, overhead and profit, materials, equipment, appliances, bailing, shoring, shoring removal, etc., to cover all work.

(3) The following Unit Prices are required where applicable to particular Base Bid and/or Alternate being submitted.

(4) Only a single Unit Price shall be given and it shall apply for either MORE or LESS work than that indicated on Drawings and called for in Specifications as indicated to be included in Base Bid and/or Alternates. In the event that more or less units than so indicated is actually furnished, Change Orders will be issued for increased or decreased amounts as approved by the Owner.

(5) Bidder understands that the Owner will not be liable for any Unit Price or any amount in excess of Base Bid and any Alternate(s) accepted at time of award of Contract, except as expressed in written Change Orders duly executed and delivered by Owner's Representative.

(6) **Lean Concrete Under Footings (Section 03 33 00 – Cast In-Place Concrete):** Unit price for lean concrete under the footings at shallow bedrock as required by the geotechnical report and structural drawings/specifications. This includes all materials, equipment, and labor for per the drawings.

(a) Lean Concrete Under Footings,
Base Bid quantity = _____20_____ cu. yd. $_____/ cu. yd..

(7) **Unsuitable Soil (Section 31 20 00 – Earth Moving):** Unit price for removal of unsuitable soil below exposed subgrade in excavations other than drilled piers as directed by the inspection and testing agency and replacement with compacted suitable soil. Exposed subgrade shall be considered the surface or elevation remaining after completion of excavation to required elevation indicated in drawings and specifications.

(a) Unsuitable Soil,
Base Bid quantity = 200 cu. yd. $_____/cu. yd.

(8) **Rock Excavation (Section 31 20 00 – Earth Moving):** Unit price for rock excavation in excavations other than drilled piers, as defined on drawings and specifications.

(a) Rock Excavation,
Base Bid quantity = 50 cu. yd. $_____/cu. yd.

(9) **Drilled Pier in Unclassified Material (Section 31 63 29 – Drilled Concrete Piers and Shafts):** Unit price for drilling in unclassified material as part of the concrete pier installation to reach the top of the rock socket as required by the geotechnical report and structural drawings/specifications. This includes all materials, equipment, and labor for the maximum sized pier installation per the drawings.

(a) Drilled Piers in Unclassified Material,
Base Bid quantity = 750 lineal ft. $_____/ lineal ft.

(10) **Drilled Pier for Rock Socket (Section 31 63 29 – Drilled Concrete Piers and Shafts):** Unit price for drilling the rock socket as part of the concrete pier installation as required by the geotechnical report and structural drawings/specifications. This includes all materials, equipment, and labor for the maximum sized pier installation per the drawings.

(a) Drilled Piers for Rock Socket,
Base Bid quantity = 250 lineal ft. $_____/ lineal ft.

4. PROJECT

a. Contract Period - Contract period begins on the day the Contractor receives unsigned Contract, Performance Bond, Payment Bond, and "Instructions for Execution of Contract, Bonds, and Insurance Certificates." Bidder agrees to complete project within four hundred eighty seven (487) calendar days from receipt of aforementioned documents. Fifteen (15) calendar days have been allocated in construction schedule for receiving aforementioned documents from Bidder.

b. Commencement - Contractor agrees to commence work on this project after the "Notice to Proceed" is issued by the Owner. "Notice to Proceed" will be issued within seven (7) calendar days after Owner receives properly prepared and executed Contract documents listed in paragraph 4.a. above.

c. Special Scheduling Requirements:
1) Contractor shall coordinate delivery with Owner's Representative and equipment supplier as well as furnish crane, receive, unload, store and install Owner-Furnished equipment.
2) The project shall be completed as necessary to provide uninterrupted operation of the campus utility systems.
3) The sequencing and scheduling of all work shall be dependent on and subject to the Research Commons Thermal Plant operations.
4) All work shall be scheduled with the Owner's Representative and be subject to the Owner's approval prior to proceeding.
5) Demolition and new construction shall be phased as required to maintain the operation of the Research Commons Thermal Plant.
6) The project requires outages to the Research Commons Thermal Plant utility systems. Contractor shall complete all related work to the maximum extent possible prior to the start of outages. Contractor shall have all required materials on site prior to start of outages.
7) Utility outages shall be coordinated with the Owner's Representative and are weather dependent. Contractor shall notify Owner's Representative 10 working days in advance of desired outage time. Owner's Representative will give Contractor 3 working days advance notice of actual time for outages.
8) No outages are anticipated for mechanical system tie-ins including chilled water, domestic water,

soft water, RO flush, steam, and condensate. Isolation valves are in-place for Contractor tie-ins.

9) Outages are anticipated for the following systems and shall take place from April to October:
   (a) Electrical Power.
   (b) UPS Power.
   (c) Fire Suppression (Sprinklers).
   (d) Fire Detection System.
   (e) Access Control.

5. SUBCONTRACTOR LIST:

Bidder hereby certifies that the following Subcontractors will be used in performance of Work:

NOTE: Failure to list Subcontractors for each category of work identified on this form or listing more than one Subcontractor for any category of work without designating the portion of work performed by each shall be grounds for rejection of bid. List name, city, and state of designated Subcontractor, for each category of work listed in Bid For Lump Sum Contract. If work within a category will be performed by more than one Subcontractor, Bidder shall provide name, city, and state of each Subcontractor and specify exact portion of work to be performed by each. If acceptance/non-acceptance of Alternates will affect designation of a Subcontractor, Bidder shall provide information, for each affected category, with this bid form. If Bidder intends to perform any designated subcontract work by using Bidder's own employees, then Bidder shall list their own name, city, and state. The bidder may petition the Owner to change a listed Subcontractor only within 48 hours of the bid opening. See Information For Bidders Section 16 List of Subcontractors for requirements.

Work to be performed	Subcontractor Name, City, State
Mechanical	_____
Electrical	_____

6. SUPPLIER DIVERSITY PARTICIPATION GOALS

a. The Contractor shall have as a goal, subcontracting with Minority Business Enterprise (MBE) of ten percent (10%), with Service Disabled Veteran Owned Business (SDVE) of three percent (3%); and with Women Business Enterprise (WBE), Disadvantage Business Enterprise (DBE), and/or Veteran Owned Business of ten percent (10%), of awarded contract price for work to be performed.

b. Requests for waiver of this goal shall be submitted on the attached Application For Waiver form. A determination by the Director of Facilities Planning & Development, UM, that a good faith effort has not been made by Contractor to achieve above stated goal may result in rejection of bid.

c. The Undersigned proposes to perform work with following Supplier Diversity participation level:

MBE PERCENTAGE PARTICIPATION:

_____ percent (_____%)

WBE, DBE, and/or VETERAN PERCENTAGE PARTICIPATION

_____ percent (_____%)

SDVE PERCENTAGE PARTICIPATION:

_____ percent (_____%)

d. A Supplier Diversity Compliance Evaluation form shall be submitted with this bid for each diverse Subcontractor to be used on this project.

7. BIDDER'S ACKNOWLEDGMENTS

a. Bidder declares that he has had an opportunity to examine the site of the work and he has examined Contract Documents therefore; that he has carefully prepared his bid upon the basis thereof; that he has carefully examined and checked bid, materials, equipment and labor required thereunder, cost thereof, and his figures therefore. Bidder hereby states that amount, or amounts, set forth in bid is, or are, correct and that no mistake or error has occurred in bid or in Bidder's computations upon which this bid is based. Bidder agrees that he will make no claim for reformation, modifications, revisions or correction of bid after scheduled closing time for receipt of bids.

b. Bidder agrees that bid shall not be withdrawn for a period of ninety (90) days after scheduled closing time for receipt of bids.

c. Bidder understands that Owner reserves right to reject any or all bids and to waive any informalities in bidding.

d. Accompanying the bid is a bid bond, or a certified check or a cashier's check payable without condition to "The Curators of the University of Missouri" which is an amount at least equal to five percent (5%) of amount of largest possible total bid herein submitted, including consideration of Alternates.

e. Accompanying the bid is a Bidder's Statement of Qualifications. Failure of Bidder to submit the Bidder's Statement of Qualifications with the bid may cause the bid to be rejected. Owner does not maintain Bidder's Statements of Qualifications on file.

f. It is understood and agreed that bid security of two (2) lowest and responsive Bidders will be retained until Contract has been executed and an acceptable Performance Bond and Payment Bond has been furnished. It is understood and agreed that if the bid is accepted and the undersigned fails to execute the Contract and furnish acceptable Performance/Payment Bond as required by Contract Documents, accompanying bid security will be realized upon or retained by Owner. Otherwise, the bid security will be returned to the undersigned.

8. BIDDER'S CERTIFICATE

Bidder hereby certifies:

a. His bid is genuine and is not made in interest of or on behalf of any undisclosed person, firm or corporation, and is not submitted in conformity with any agreement or rules of any group, association or corporation.

b. He has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid.

c. He has not solicited or induced any person, firm or corporation to refrain from bidding.

d. He has not sought by collusion or otherwise to obtain for himself any advantage over any other Bidder or over Owner.

e. He will not discriminate against any employee or applicant for employment because of race, color, religion, sex or national origin in connection with performance of work.

f. By virtue of policy of the Board of Curators, and by virtue of statutory authority, a preference will be given to materials, products, supplies, provisions and all other articles produced, manufactured, mined or grown within the State of Missouri. By virtue of policy of the Board of Curators, preference will also be given to all Missouri firms, corporations, or individuals, all as more fully set forth in "Information For Bidders."

END OF BIDDER'S CERTIFICATE

9. BIDDER'S SIGNATURE

Note: All signatures shall be original; not copies, photocopies, stamped, etc.

Authorized Signature	Date
Printed Name	Title
Company Name	
Mailing Address	
City, State, Zip	
Phone No.	Federal Employer ID No.
Fax No.	E-Mail Address
Circle one: Individual Partnership Corporation Joint Venture	
If a corporation, incorporated under the laws of the State of_____	
Licensed to do business in the State of Missouri? ____yes _____no	

(Each Bidder shall complete bid form by manually signing on the proper signature line above and supplying required information called for in connection with the signature. Information is necessary for proper preparation of the Contract, Performance Bond and Payment Bond. Each Bidder shall supply information called for in accompanying "Bidder's Statement of Qualifications.")

END OF SECTION

SECTION 1.E.3
SHOP DRAWING AND SUBMITTAL LOG

Project: R**esearch Common Thermal Plant – Chilled Water Production Addition**
Project Number: **CP232801**
Contractor:

Section	Submittal Number	Description	Type	Contractor	Date Received	Date Returned	Status	Comments
1.E		Special Conditions: Crane Operator Certificates	I					
1.E		Special Conditions: Crane Rigger Qualifications	I					
1.E		Special Conditions : Crane Signal Person Qualifications	I					
1.E		Special Conditions: Lift Plans	I					
03 30 00		Cast-in-Place Concrete: Product Data	A					
03 30 00		Cast-in-Place Concrete: Design Mixtures	A					
03 30 00		Cast-in-Place Concrete: Shop Drawings	A					
03 30 00		Cast-in-Place Concrete: Material Certificates	I					
03 30 00		Cast-in-Place Concrete: Material Test Reports	I					
03 30 00		Cast-in-Place Concrete: Surface Measurements	I					
04 20 00		Concrete Unit Masonry: Product Data	A					
04 20 00		Concrete Unit Masonry: Design Mixtures	A					
04 20 00		Concrete Unit Masonry: Shop Drawings	A					
04 20 00		Concrete Unit Masonry: Samples	A					
04 20 00		Concrete Unit Masonry: Qualification Data	I					
04 20 00		Concrete Unit Masonry: Material Certificates	I					
05 12 00		Structural Steel Framing: Product Data	A					
05 12 00		Structural Steel Framing: Shop Drawings	A					
05 12 00		Structural Steel Framing: Qualification Data	I					
05 12 00		Structural Steel Framing: Welding Certificates	I					
05 12 00		Structural Steel Framing: Mill Test Reports	I					
05 12 00		Structural Steel Framing: Source Quality Reports	I					

Section	Submittal Number	Description	Type	Contractor	Date Received	Date Returned	Status	Comments
05 12 13		Exposed Structural Steel Framing: Shop Drawings	A					
05 12 13		Exposed Structural Steel Framing: Samples	A					
05 31 00		Steel Decking: Product Data	A					
05 31 00		Steel Decking: Shop Drawings	A					
05 31 00		Steel Decking: Welding Certificates	I					
05 31 00		Steel Decking: Product Certificates	I					
05 31 00		Steel Decking: Evaluation Reports	I					
05 31 00		Steel Decking: Field Quality Reports	I					
05 40 00		Cold-Formed Metal Framing: Product Data	A					
05 40 00		Cold-Formed Metal Framing: Shop Drawings	A					
05 40 00		Cold-Formed Metal Framing: Qualification Data	I					
05 40 00		Cold-Formed Metal Framing: Welding Certificates	I					
05 40 00		Cold-Formed Metal Framing: Product Test Reports	I					
05 40 00		Cold-Formed Metal Framing: Research/Evaluation Reports	I					
05 50 00		Metal Fabrications: Product Data	A					
05 50 00		Metal Fabrications: Shop Drawings	A					
05 50 00		Metal Fabrications: Welding Certificates	I					
05 52 13		Pipe and Tube Railings: Product Data	A					
05 52 13		Pipe and Tube Railings: Shop Drawings	A					
05 52 13 [1]		**Pipe and Tube Railings: Delegated Design**	**A**					
05 52 13		Pipe and Tube Railings: Welding Certificates	I					
06 10 00		Rough Carpentry: Product Data	A					
06 10 00		Rough Carpentry: Shop Drawings	A					
06 10 00		Rough Carpentry: Certifications	I					
07 13 54		Thermoplastic Sheet Waterproofing: Product Data	A					
07 13 54		Thermoplastic Sheet Waterproofing: Shop Drawings	A					
07 13 54		Thermoplastic Sheet Waterproofing: Qualification Data	I					

Section	Submittal Number	Description	Type	Contractor	Date Received	Date Returned	Status	Comments
07 13 54		Thermoplastic Sheet Waterproofing: Field QC Reports	I					
07 13 54		Thermoplastic Sheet Waterproofing: Sample Warranties	I					
07 14 16		Cold Fluid Applied Waterproofing: Product Data	A					
07 14 16		Cold Fluid Applied Waterproofing: Shop Drawings	A					
07 14 16		Cold Fluid Applied Waterproofing: Qualification Data	I					
07 14 16		Cold Fluid Applied Waterproofing: Product Test Results	I					
07 14 16		Cold Fluid Applied Waterproofing: Sample Warranty	I					
07 14 16		Cold Fluid Applied Waterproofing: Field QC Reports	I					
07 14 13-16 [1]		**Standing-Seam Metal Roof Panels: Product Data**	**A**					
07 14 13-16 [1]		**Standing-Seam Metal Roof Panels: Shop Drawings**	**A**					
07 14 13-16 [1]		**Standing-Seam Metal Roof Panels: Samples (Initial)**	**A**					
07 14 13-16 [1]		**Standing-Seam Metal Roof Panels: Samples (Verification)**	**A**					
07 14 13-16 [1]		**Standing-Seam Metal Roof Panels: Certificates**	**I**					
07 14 13-16 [1]		**Standing-Seam Metal Roof Panels: Test Reports**	**I**					
07 14 13-16 [1]		**Standing-Seam Metal Roof Panels: Field QC Reports**	**I**					
07 14 13-16 [1]		**Standing-Seam Metal Roof Panels: Qualifications**	**I**					
07 14 13-16 [1]		**Standing-Seam Metal Roof Panels: Sample Warranties**	**I**					
07 42 13-19		Insulated Metal Wall Panels: Product Data	A					
07 42 13-19		Insulated Metal Wall Panels: Shop Drawings	A					
07 42 13-19		Insulated Metal Wall Panels: Panel Analysis	A					
07 42 13-19		Insulated Metal Wall Panels: Samples	A					
07 42 13-19		Insulated Metal Wall Panels: QC Assurance	**I** [1]					
07 54 23 [1]		**TPO Roofing: Product Data**	**A**					
07 54 23 [1]		**TPO Roofing: Shop Drawings**	**A**					
07 54 23 [1]		**TPO Roofing: Samples (Verification)**	**A**					
07 54 23 [1]		**TPO Roofing: Wind Uplift Resistance**	**A**					
07 54 23 [1]		**TPO Roofing: Certificates**	**I**					

Section	Submittal Number	Description	Type	Contractor	Date Received	Date Returned	Status	Comments
07 54 23 [1]		**TPO Roofing: Source QC Test Reports**	**I**					
07 54 23 [1]		**TPO Roofing: Field QC Test Reports**	**I**					
07 54 23 [1]		**TPO Roofing: Sample Warranties**	**I**					
07 62 00 [1]		**Sheet Metal Flashing & Trim: Product Data**	**A**					
07 62 00 [1]		**Sheet Metal Flashing & Trim: Shop Drawings**	**A**					
07 62 00 [1]		**Sheet Metal Flashing & Trim: Samples (Initial)**	**A**					
07 62 00 [1]		**Sheet Metal Flashing & Trim: Samples (Verification)**	**A**					
07 62 00 [1]		**Sheet Metal Flashing & Trim: Certificates**	**I**					
07 62 00 [1]		**Sheet Metal Flashing & Trim: Source QC Test Reports**	**I**					
07 62 00 [1]		**Sheet Metal Flashing & Trim: Field QC Test Reports**	**I**					
07 62 00 [1]		**Sheet Metal Flashing & Trim: Qualifications**	**I**					
07 62 00 [1]		**Sheet Metal Flashing & Trim: Sample Warranties**	**I**					
07 72 53 [1]		**Snow Guards: Product Data**	**A**					
07 72 53 [1]		**Snow Guards: Shop Drawings**	**A**					
07 72 53 [1]		**Snow Guards: Samples**	**A**					
07 72 53 [1]		**Snow Guards: Source QC Test Reports**	**I**					
07 81 00 [1]		**Applied Fire Protection: Product Data**	**A**					
07 81 00 [1]		**Applied Fire Protection: Shop Drawings**	**A**					
07 81 00 [1]		**Applied Fire Protection: Source QC Test Reports**	**I**					
07 81 00 [1]		**Applied Fire Protection: Field QC Reports**	**I**					
07 81 00 [1]		**Applied Fire Protection: Qualifications**	**I**					
07 84 13		Penetration Firestopping: Product Data	A					
07 84 13		Penetration Firestopping: Product Schedule	A					
07 84 13		Penetration Firestopping: Unlisted Firestopping System	A					
07 84 13		Penetration Firestopping: Qualification Data	I					
07 84 13		Penetration Firestopping: Listed System Designs	I					
07 92 00		Joint Sealants: Shop Drawings	A					

Section	Submittal Number	Description	Type	Contractor	Date Received	Date Returned	Status	Comments
07 92 00		Joint Sealants: Samples	A					
07 92 00		Joint Sealants: Installation Instructions	I					
07 92 00		Joint Sealants: Applicator Qualifications	I					
07 92 00		Joint Sealants: Test Results	I					
08 11 13		Hollow Metal Doors and Frames: Product Data	A					
08 11 13		Hollow Metal Doors and Frames: Shop Drawings	A					
08 11 13		Hollow Metal Doors and Frames: Samples	A					
08 11 13		Hollow Metal Doors and Frames: Product Schedule	A					
08 31 13 [1]		**Access Doors: Product Data**	**A**					
08 31 13 [1]		**Access Doors: Shop Drawings**	**A**					
08 31 13 [1]		**Access Doors: Installation Instructions**	**I**					
08 31 13 [1]		**Access Doors: Sample Warranties**	**I**					
08 35 13.13		Vertically Bi-Fold Hanger Doors: Product Data	A					
08 35 13.13		Vertically Bi-Fold Hanger Doors: Shop Drawings	A					
08 35 13.13		Vertically Bi-Fold Hanger Doors: Samples	A					
08 35 13.13		Vertically Bi-Fold Hanger Doors: Sample Warranty	I					
08 35 13.13 [1]		**Vertically Bi-Fold Hanger Doors: O&M Data**	**I**					
08 41 13		Aluminum Framed Windows: Product Data	A					
08 41 13		Aluminum Framed Windows: Shop Drawings	A					
08 41 13		Aluminum Framed Windows: Samples	A					
08 41 13		Aluminum Framed Windows: Product Schedule	A					
08 41 13		Aluminum Framed Windows: Test & Evaluation Reports	I					
08 41 13		Aluminum Framed Windows: Field QC Reports	I					
08 41 13		Aluminum Framed Windows: Qualifications Statements	I					
08 41 13		Aluminum Framed Windows: Sample Warranties	I					
08 71 00		Door Hardware: Product Data Shop Drawings	A					
08 71 00		Door Hardware: Shop Drawings	A					

Section	Submittal Number	Description	Type	Contractor	Date Received	Date Returned	Status	Comments
08 71 00		Door Hardware: Door Hardware Schedule	A					
08 71 00		**Door Hardware: Installation Instructions [1]**	I					
08 71 00		Door Hardware: Sample Warranties	I					
08 91 19 [1]		**Fixed Louvers: Product Data**	**A**					
08 91 19 [1]		**Fixed Louvers: Shop Drawings**	**A**					
08 91 19 [1]		**Fixed Louvers: Samples**	**A**					
08 91 19 [1]		**Fixed Louvers: Test Reports - Products**	**I**					
08 91 19 [1]		**Fixed Louvers: Sample Warranties**	**I**					
08 95 16		Safety Venting: Product Data	A					
08 95 16		Safety Venting: Shop Drawings	A					
08 95 16		Safety Venting: Installation Instructions	I					
09 67 23 [1]		Resinous Flooring: Product Data	A					
09 67 23 [1]		Resinous Flooring: Samples	A					
09 67 23 [1]		Resinous Flooring: Qualification Data - Installer	I					
09 67 23 [1]		Resinous Flooring: Material Certificates	I					
09 67 23 [1]		Resinous Flooring: Material Test Reports	I					
09 67 23 [1]		Resinous Flooring: Field QC Reports	I					
09 91 00		Painting: Product Data	A					
09 91 00		Painting: Manufacturer’s Instructions	A					
09 91 23		Architectural Painting: Shop Drawings	A					
09 91 23 [1]		Architectural Painting: Samples	A					
09 91 23 [1]		Architectural Painting: Product List	A					
10 44 33		Fire Protection Specialties: Product Data	A					
21 13 13		Fire Sprinkler Systems: Delegated Design	A					
21 13 13		Fire Sprinkler Systems: Product Data	A					
21 13 13		Fire Sprinkler Systems: Shop Drawings	A					
21 13 13		Fire Sprinkler Systems: Permit Approved Dwgs	I					

Section	Submittal Number	Description	Type	Contractor	Date Received	Date Returned	Status	Comments
21 22 00		Clean Agent Extinguishing Systems: Product Data	A					
21 22 00		Clean Agent Extinguishing Systems: Shop Drawings	A					
21 22 00		Clean Agent Extinguishing Systems: Delegated Design	A					
21 22 00		Clean Agent Extinguishing Systems: Permit Approved Dwgs	I					
21 22 00		Clean Agent Extinguishing Systems: Seismic Qualifications	I					
21 22 00		Clean Agent Extinguishing Systems: Field QC Reports	I					
22 05 29		Hangers & Support for Plumbing: Product Data	A					
22 05 29		Hangers & Support for Plumbing: Shop Drawings	A					
22 05 29 [1]		**Hangers & Support for Plumbing: Installation Instructions**	**I**					
22 05 48 [1]		**Vibration & Seismic Cntrls for Plumbing: Product Data**	**A**					
22 05 48 [1]		**Vibration & Seismic Cntrls for Plumbing: Shop Drawings**	**A**					
22 05 48 [1]		**Vibration & Seismic Cntrls for Plumbing: Install. Instruct.**	**I**					
22 05 53 [1]		**Identification for Plumbing: Product Data**	**A**					
22 05 53 [1]		**Identification for Plumbing: Installation Instructions**	**I**					
22 07 10 [1]		**Plumbing Insulation: Product Data**	**A**					
22 07 10 [1]		**Plumbing Insulation: Shop Drawings**	**A**					
22 07 10 [1]		**Plumbing Insulation: Safety Data Sheets**	**A**					
22 07 10 [1]		**Plumbing Insulation: Source QC Reports**	**I**					
22 07 10 [1]		**Plumbing Insulation: Installation Instructions**	**I**					
22 07 10 [1]		**Plumbing Insulation: Field QC Report**	**I**					
22 10 10 [1]		**Piping for Plumbing: Product Data**	**A**					
22 10 10 [1]		**Piping for Plumbing: Shop Drawings**	**A**					
22 10 10 [1]		**Piping for Plumbing: Installation Instructions**	**I**					
22 10 10 [1]		**Piping for Plumbing: Test Procedures**	**I**					
22 10 10 [1]		**Piping for Plumbing: Welding Certificates**	**I**					
22 10 10 [1]		**Piping for Plumbing: Source QC Reports**	**I**					
22 10 19 [1]		**Plumbing Piping Specialties: Product Data**	**A**					

Section	Submittal Number	Description	Type	Contractor	Date Received	Date Returned	Status	Comments
22 10 19 [1]		**Plumbing Piping Specialties: Installation Instructions**	**I**					
22 10 19 [1]		**Plumbing Piping Specialties: Source QC Test Reports**	**I**					
22 30 00 [1]		**Plumbing Equipment: Product Data**	**A**					
22 30 00 [1]		**Plumbing Equipment: Installation Instructions**	**I**					
22 30 00 [1]		**Plumbing Equipment: Source QC Test Reports**	**I**					
23 05 29 [1]		**Hangers & Supports for HVAC: Product Data**	**A**					
23 05 29 [1]		**Hangers & Supports for HVAC: Shop Drawings**	**A**					
23 05 29 [1]		**Hangers & Supports for HVAC: Installation Instructions**	**I**					
23 05 33 [1]		**Heat Tracing for HVAC Piping: Product Data**	**A**					
23 05 33 [1]		**Heat Tracing for HVAC Piping: Schedule**	**A**					
23 05 33 [1]		**Heat Tracing for HVAC Piping: Shop Drawings**	**A**					
23 05 33 [1]		**Heat Tracing for HVAC Piping: Calculations**	**A**					
23 05 33 [1]		**Heat Tracing for HVAC Piping: Installation Instructions**	**I**					
23 05 48		**Vibration & Seismic Cntrls for HVAC: Product Data** [1]	A					
23 05 48		**Vibration & Seismic Cntrls for HVAC Shop Drawings** [1]	A					
23 05 48		**Vibration & Seismic Cntrls for HVAC: Install. Instr.** [1]	I					
23 05 53 [1]		**Identification for HVAC: Product Data**	**A**					
23 05 53 [1]		**Identification for HVAC: Installation Instructions**	**I**					
23 07 00 [1]		**HVAC Duct Insulation: Product Data**	**A**					
23 07 00 [1]		**HVAC Duct Insulation: Installation Instructions**	**I**					
23 07 19 [1]		**HVAC Piping Insulation: Product Data**	**A**					
23 07 19 [1]		**HVAC Piping Insulation: Shop Drawings**	**A**					
23 07 19 [1]		**HVAC Piping Insulation: Safety Data Sheets**	**A**					
23 07 19 [1]		**HVAC Piping Insulation: Installation Instructions**	**I**					
23 07 19 [1]		**HVAC Piping Insulation: Source QC Test Reports**	**I**					
23 07 19 [1]		**HVAC Piping Insulation: Field QC Test Reports**	**I**					
23 09 00		Building Automation System: Product Data	A					

Section	Submittal Number	Description	Type	Contractor	Date Received	Date Returned	Status	Comments
23 09 00		Building Automation System: Shop Drawings	A					
23 09 00		Building Automation System: Factory Reports	I					
23 21 13 [1]		**Piping for HVAC: Product Data**	**A**					
23 21 13 [1]		**Piping for HVAC: Shop Drawings**	**A**					
23 21 13 [1]		**Piping for HVAC: Installation Instructions**	**I**					
23 21 13 [1]		**Piping for HVAC: Test Procedures**	**I**					
23 21 13 [1]		**Piping for HVAC: Welder's Certificates**	**I**					
23 21 13 [1]		**Piping for HVAC: Source QC Test Reports**	**I**					
23 21 16 [1]		**Piping Specialties for HVAC: Product Data**	**A**					
23 21 16 [1]		**Piping Specialties for HVAC: Installation Instructions**	**I**					
23 21 16 [1]		**Piping Specialties for HVAC: Source QC Test Reports**	**I**					
23 21 13		Hydronic Pumps: Certified Data Sheet	A					
23 21 13		Hydronic Pumps: Product Data	A					
23 21 13		Hydronic Pumps: Charact. Pump Curve (Constant Speed)	A					
23 21 13		Hydronic Pumps: Charact. Pump Curves (Variable Speed)	A					
23 21 13		Hydronic Pumps: Charact. Pump Curves (Parallel Pumps)	A					
23 21 13		Hydronic Pumps: General Arrangement	A					
23 21 13		Hydronic Pumps: Installation Instructions	I					
23 21 13		Hydronic Pumps: Operational Information	I					
23 21 13		Hydronic Pumps: Source Quality Control	I					
23 21 13		Hydronic Pumps: Handling Information	I					
23 21 13		Hydronic Pumps: Spare Parts List	I					
23 21 13		Hydronic Pumps: Sample Warranty	I					
23 21 13		Hydronic Pumps: Operation and Maintenance Data	I					
23 21 13		Hydronic Pumps: Factory Test Reports	I					
23 21 13		Hydronic Pumps: Field Test Reports	I					
23 25 00 [1]		**HVAC Water Treatment: Product Data**	**A**					

Section	Submittal Number	Description	Type	Contractor	Date Received	Date Returned	Status	Comments
23 25 00 [1]		**HVAC Water Treatment: Shop Drawings**	**A**					
23 25 00 [1]		**HVAC Water Treatment: Installation Instructions**	**I**					
23 25 26		Sand Filter System: Product Data	A					
23 25 26		Sand Filter System: Shop Drawings	A					
23 25 26		Sand Filter System: Spare Parts List	I					
23 25 26		Sand Filter System: Sample Warranty	I					
23 25 26		Sand Filter System: Operation and Maintenance Data	I					
23 25 26		Sand Filter System: Factory Test Reports	I					
23 25 26		Sand Filter System: Field Test Reports	I					
23 31 00		HVAC Ducts and Casings: Product Data	A					
23 31 00		HVAC Ducts and Casings: Shop Drawings	A					
23 31 00		HVAC Ducts and Casings: Operation and Maintenance Data	I					
23 31 00		HVAC Ducts and Casings: Factory Test Reports	I					
23 33 00		Air Duct Accessories: Product Data	A					
23 33 00		Air Duct Accessories: Shop Drawings	A					
23 33 00		Air Duct Accessories: Factory Test Reports	I					
23 34 00		HVAC Fans: Product Data	A					
23 34 00		HVAC Fans: Shop Drawings	A					
23 34 00		HVAC Fans: Installation Instructions	I					
23 37 00		Air Outlets and Inlets: Product Data	A					
23 37 00		Air Outlets and Inlets: Test Reports	I					
23 51 01 [1]		**Boiler Stack: Product Data**	**A**					
23 51 01 [1]		**Boiler Stack: Shop Drawings**	**A**					
23 51 01 [1]		**Boiler Stack: Calculations**	**A**					
23 51 01 [1]		**Boiler Stack: Installation Instructions**	**I**					
23 51 01 [1]		**Boiler Stack: Sample Warranties**	**I**					
23 65 14 [1]		Induced Draft Cooling Towers: Data Sheets	A					

Section	Submittal Number	Description	Type	Contractor	Date Received	Date Returned	Status	Comments
23 65 14 [1]		Induced Draft Cooling Towers: Bill of Materials	A					
23 65 14 [1]		Induced Draft Cooling Towers: Performance Curves	A					
23 65 14 [1]		Induced Draft Cooling Towers: Sound Performance Data	A					
23 65 14 [1]		Induced Draft Cooling Towers: Evap Drift, and Blowdown Data	A					
23 65 14 [1]		Induced Draft Cooling Towers: Fan Perform Data and Curves	A					
23 65 14 [1]		Induced Draft Cooling Towers: Mechanical Equipment Dwgs	A					
23 65 14 [1]		Induced Draft Cooling Towers: General Arrangement Dwgs	A					
23 65 14 [1]		Induced Draft Cooling Towers: Installation Instructions	I					
23 65 14 [1]		Induced Draft Cooling Towers: Lifting & Rigging	I					
23 65 14 [1]		Induced Draft Cooling Towers: Tower Foundation Details	I					
23 65 14 [1]		Induced Draft Cooling Towers: Motor Data	I					
23 65 14 [1]		Induced Draft Cooling Towers: Electrical Wiring Diagrams	I					
23 65 14 [1]		Induced Draft Cooling Towers: Harmonic Frequencies	I					
23 65 14 [1]		Induced Draft Cooling Towers: Instrument Data Sheets	I					
23 65 14 [1]		Induced Draft Cooling Towers: Recommended Lubricants	I					
23 65 14 [1]		Induced Draft Cooling Towers: Sample Warranty	I					
23 65 14 [1]		Induced Draft Cooling Towers: Sample Service Agreement	I					
23 65 14 [1]		Induced Draft Cooling Towers: Factory Test Reports	I					
23 65 14 [1]		Induced Draft Cooling Towers: Field QC Test Reports	I					
23 73 00		Indoor Central Station Air Handling Units: Product Data	A					
23 73 00		Indoor Central Station Air Handling Units: Shop Drawings	A					
23 73 00		Indoor Central Station Air Handling Units: Install Instruct	I					
23 82 39		Unit Heaters: Product Data	A					
23 82 39		Unit Heaters: Shop Drawings	A					
23 82 39		Unit Heaters: Installation Instructions	I					
26 05 19		LV Electrical Power Conductors and Cables: Product Data	A					
26 05 26		Grounding & Bonding for Electrical Systems: Product Data	A					

Section	Submittal Number	Description	Type	Contractor	Date Received	Date Returned	Status	Comments
26 05 26		Grounding & Bonding for Electrical Systems: Install. Instruct.	I					
26 05 26		Grounding & Bonding for Electrical Systems: Field QC Reports	I					
26 05 33		Raceway & Boxes for Electrical Systems: Product Data	A					
26 05 36		Cable Trays for Electrical Systems: Product Data	A					
26 05 36		Cable Trays for Electrical Systems: Shop Drawings	A					
26 05 36		Cable Trays for Electrical Systems: Installation Instructions	I					
26 05 48		Seismic Protection for Electrical Equipment: Product Data	A					
26 05 48		Seismic Protection for Electrical Equipment: Shop Drawings	A					
26 05 48		Seismic Protection for Electrical Equipment: Install. Instruct.	I					
26 05 53		Identification for Electrical Systems: Product Data	A					
26 05 53		Identification for Electrical Systems: Shop Drawings	A					
26 05 73		LV Electrical System Studies: Delegated Design	A					
26 05 73		LV Electrical System Studies: Study Documentation	A					
26 05 73		LV Electrical System Studies: Pre-final Report	A					
26 05 73		LV Electrical System Studies: Final Report	A					
26 22 00		LV Transformers: Product Data	A					
26 22 00		LV Transformers: Shop Drawings	A					
26 22 00 [1]		**LV Transformers: Installation Instructions**	**I**					
26 22 00		LV Transformers: Seismic Certification	I					
26 24 16		Panelboards: Product Data	A					
26 24 16		Panelboards: Shop Drawings	A					
26 24 16 [1]		**Panelboards: Installation Instructions**	**I**					
26 24 16		Panelboards: Seismic Certification	I					
26 28 16		Enclosed Switches: Product Data	A					
26 29 13 [1]		**Enclosed Motor Controllers: Product Data**	**A**					
26 29 13 [1]		**Enclosed Motor Controllers: Shop Drawings**	**A**					
26 29 13 [1]		**Enclosed Motor Controllers: Installation Instructions**	**I**					

Section	Submittal Number	Description	Type	Contractor	Date Received	Date Returned	Status	Comments
26 29 13 [1]		**Enclosed Motor Controllers: Spare Parts**	**I**					
26 29 23		Variable Frequency Motor Controllers: Bill of Material	A					
26 29 23		Variable Frequency Motor Controllers: Product Data	A					
26 29 23		Variable Frequency Motor Controllers: General Arrangements	A					
26 29 23		Variable Frequency Motor Controllers: Wiring Diagrams	A					
26 29 23		Variable Frequency Motor Controllers: Source QC	I					
26 29 23		Variable Frequency Motor Controllers: Handling Information	I					
26 29 23		Variable Frequency Motor Controllers: Spart Parts List	I					
26 29 23		Variable Frequency Motor Controllers: Sample Warranty	I					
26 29 23		Variable Frequency Motor Controllers: Factory Test Reports	I					
26 29 23		Variable Frequency Motor Controllers: Field Test Reports	I					
26 41 00 [1]		**Facility Lightning Protection: Delegated Design**	**A**					
26 41 00		Facility Lightning Protection: Product Data	A					
26 41 00		Facility Lightning Protection: Shop Drawings	A					
26 41 00		Facility Lightning Protection: Installer Qualifications	I					
26 41 00		Facility Lightning Protection: Inspector Qualifications	I					
26 41 00		Facility Lightning Protection: Field QC Test Reports	I					
26 41 00		Facility Lightning Protection: Certificate of Compliance	I					
26 51 00		Lighting and Receptacles: Product Data	A					
26 51 00		Lighting and Receptacles: Shop Drawings	A					
26 51 00		Lighting and Receptacles: Spart Part List	I					
28 31 11		Addressable Fire Alarm System: Product Data	A					
28 31 11		Addressable Fire Alarm System: Shop Drawings	A					
28 31 11 [1]		**Addressable Fire Alarm System: Permit Approved Dwgs**	**I**					
31 02 70		Sediment and Erosion Control: SWPPP	A					
31 02 70		Sediment and Erosion Control: Product Data	A					
31 02 70		Sediment and Erosion Control: Shop Drawings	A					

Section	Submittal Number	Description	Type	Contractor	Date Received	Date Returned	Status	Comments
31 10 00		Site Clearing: Existing Conditions	I					
31 20 00		Earth Moving: Product Data	A					
31 20 00 [1]		**Earth Moving: Delegated Design**	**A**					
31 20 00		Earth Moving: Existing Conditions	I					
31 50 00 [1]		**Excavation Support & Protection: Delegated Design**	**A**					
31 50 00 [1]		**Excavation Support & Protection: Existing Conditions**	**I**					
31 63 29		Drilled Concrete Piers and Shafts: Product Data	A					
31 63 29		Drilled Concrete Piers and Shafts: Design Mixtures	A					
31 63 29		Drilled Concrete Piers and Shafts: Shop Drawings	A					
31 63 29		Drilled Concrete Piers and Shafts: Material Certificates	I					
31 63 29		Drilled Concrete Piers and Shafts: Material Test Reports	I					
31 63 29		Drilled Concrete Piers and Shafts: Field QC Reports	I					
32 13 13		Concrete Paving: Product Data	A					
32 13 13		Concrete Paving: Samples	A					
32 13 13		Concrete Paving: Design Mixtures	A					
32 13 13		Concrete Paving: Qualification Data	I					
32 13 13		Concrete Paving: Material Certificates	I					
32 13 13		Concrete Paving: Material Test Reports	I					
32 32 23 [1]		**Segmental Retaining Walls: Product Data**	**A**					
32 32 23 [1]		**Segmental Retaining Walls: Shop Drawings**	**A**					
32 32 23 [1]		**Segmental Retaining Walls: Samples (Initial)**	**A**					
32 32 23 [1]		**Segmental Retaining Walls: Samples (Verification)**	**A**					
32 32 23 [1]		**Segmental Retaining Walls: Delegated Design**	**A**					
32 32 23 [1]		**Segmental Retaining Walls: Qualifications (Testing Agent)**	**I**					
32 32 23 [1]		**Segmental Retaining Walls: Qualifications (Design Prof.)**	**I**					
32 32 23 [1]		**Segmental Retaining Walls: Certificates**	**I**					
32 32 23 [1]		**Segmental Retaining Walls: Source QC Test Reports**	**I**					

Section	Submittal Number	Description	Type	Contractor	Date Received	Date Returned	Status	Comments
32 32 23 [1]		**Segmental Retaining Walls: Field QC Test Reports**	**I**					
33 11 13		Water Distribution Piping: Product Data	A					
33 11 13		Water Distribution Piping: Field QC Test Reports	I					
33 12 16		Water Utilities Distribution Valves: Product Data	A					
33 13 00 [1]		**Disinfection of Water Utilities: Product Data**	**A**					
33 13 00 [1]		**Disinfection of Water Utilities: Field QC Test Reports**	**I**					
33 31 13		Sanitary Sewers: Product Data	A					
33 31 13		Sanitary Sewers: Shop Drawings	A					
33 31 13		Sanitary Sewers: Field QC Reports	I					
33 41 00 [1]		**Storm Drainage: Product Data**	**A**					
33 41 00 [1]		**Storm Drainage: Shop Drawings**	**A**					
33 41 00 [1]		**Storm Drainage: Field QC Reports**	**I**					
33 61 13 [1]		**Hydronic Energy Distribution: Product Data**	**A**					
33 61 17 [1]		**Hydronic Energy Distribution – CHW Valves: Product Data**	**A**					
33 71 73-33 [1]		**Electrical Meters: Shop Drawings**	**A**					
33 71 73-33 [1]		**Electrical Meters: Installation Instructions**	**I**					
40 67 00 [1]		**Control System Equip Panels & Racks: Product Data**	**A**					
40 67 00 [1]		**Control System Equip Panels & Racks: Shop Drawings**	**A**					
40 67 00 [1]		**Control System Equip Panels & Racks: Spare Parts**	**I**					
40 90 00		Process Automation Control System: Device Schedule	A					
40 90 00		Process Automation Control System: Product Data	A					
40 90 00		Process Automation Control System: Calculations	A					
40 90 00		Process Automation Control System: Shop Drawings	A					
40 90 00		Process Automation Control System: Installation Instructions	I					
40 90 00		Process Automation Control System: Factory Cal. Reports	I					

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SECTION 1.E.4
OPERATING INSTRUCTIONS AND SERVICE MANUAL LOG

Project: R**esearch Common Thermal Plant – Chilled Water Production Addition**
Project Number: **CP232801**
Contractor:

Section	Description	Catalog Data	Wiring Diagrams	Installation Instructions	Service & Maintenance Instructions	Parts List & Availability	Performance Curves	Startup & Operating Instructions
07 41 13-16 [1]	**Standing-Seam Metal Roof Panels**							
07 42 13.19	Insulated Metal Wall Panels							
07 54 23 [1]	**Thermoplastic-Polyolefin (TPO) Roofing**							
07 62 00 [1]	**Sheet Metal Flashing and Trim**							
08 31 13 [1]	**Access Doors**							
08 35 13.13	Vertically Bi-Fold Hanger Doors							
08 71 00	Door Hardware							
09 67 23	Resinous Flooring							
21 13 13	Fire Sprinkler System							
21 22 00	Clean Agent Fire Extinguishing Systems							
22 10 10 [1]	**Piping for Plumbing**							
22 10 19 [1]	**Plumbing Piping Specialties**							
22 30 00 [1]	**Plumbing Equipment**							
23 05 33 [1]	**Heat Trace for HVAC Piping**							
23 09 00	Building Automation System							
23 21 13 [1]	**Piping for HVAC**							
23 21 16 [1]	**Piping Specialties for HVAC**							
23 21 13	Hydronic Pumps							
23 25 00 [1]	**HVAC Water Treatment**							
23 25 26	Sand Filter System							
23 31 00	HVAC Ducts and Casings							

Section	Description	Catalog Data	Wiring Diagrams	Installation Instructions	Service & Maintenance Instructions	Parts List & Availability	Performance Curves	Startup & Operating Instructions
23 33 00	Air Duct Accessories							
23 34 00	HVAC Fans							
23 37 00	Air Outlets and Inlets							
23 51 01 [1]	**Boiler Stack**							
23 65 14 [1]	**Induced Draft Cooling Towers**							
23 73 00	Indoor Central Station Air Handling Units							
23 82 39	Unit Heaters							
26 22 00	Low Voltage Transformers							
26 24 16	Panelboards							
26 28 16	Enclosed Switches							
23 29 13 [1]	**Enclosed Motor Controllers**							
26 29 23	Variable Frequency Motor Controllers							
26 41 00	Facility Lightning Protection							
28 31 11	Addressable Fire Alarm System							
33 12 16	Water Utilities Distribution Valves							
33 61 17	Hydronic Energy Distribution – CHW Valves							
40 90 00	Process Automation Control System							

SECTION 1.E.5
CLOSEOUT LOG

Project: R**esearch Common Thermal Plant – Chilled Water Production Addition**
Project Number: **CP232801**
Contractor:

Section	Description	Contractor / Subcontractor	Date Rec'd	# of Copies	CPM Initials	Remarks
GC 3.11	As-built drawings					
GC 13.5.6	Final Affidavit of Supplier Diversity Participation for each Diverse Firm					
SC 20	Executed commissioning plan w/ required documentation					
03 30 00	Cast-in-Place Concrete: Moisture Vapor Admixture Warranty (10-year)					
07 13 54	**Thermoplastic Sheet Waterproofing: Warranty (20-year)** [1]					
07 14 16	Cold Fluid Applied Waterproofing: Warranty (20-year)					
07 42 13-16 [1]	**Standing-Seam Metal Roof Panels: Materials and Workmanship Warranty (2-year)**					
07 42 13-16 [1]	**Standing-Seam Metal Roof Panels: Finish Warranty (20-year)**					
07 42 13-16 [1]	**Standing-Seam Metal Roof Panels: Thermal Warranty (20-year)**					
07 42 13-19	Insulated Metal Wall Panels: Materials and Workmanship Warranty (2-year)					
07 42 13-19	Insulated Metal Wall Panels: Finish Warranty					
07 42 13-19	Insulated Metal Wall Panels: Thermal Warranty (30-year)					
07 54 23 [1]	**Thermoplastic-Polyolefin (TPO) Roofing: Materials and Workmanship Warranty (20-year)**					
07 54 23 [1]	**Thermoplastic-Polyolefin (TPO) Roofing: Installer's Warranty (2-year)**					
07 62 00 [1]	**Sheet Metal Flashing and Trim: Finish Warranty (20-year)**					
07 84 13	Penetration Firestopping: Installer Certificates					
08 31 13 [1]	**Access Doors: Materials and Workmanship Warranty (25-year)**					
08 35 13.13	Vertically Bi-Fold Hanger Doors: Materials and Workmanship Warranty (2-Year)					

Section	Description	Contractor / Subcontractor	Date Rec'd	# of Copies	CPM Initials	Remarks
08 35 13.13	Vertically Bi-Fold Hanger Doors: Lift Straps Warranty (2-Year)					
08 41 13	Aluminum Framed Windows: Windows Warranty (10-Year)					
08 41 13	Aluminum Framed Windows: Glazing Warranty (10-Year)					
08 41 13	Aluminum Framed Windows: Hardware Warranty (3-Year)					
08 41 13	Aluminum Framed Windows: Aluminum Finish Warranty (10-Year)					
08 71 00	Door Hardware: Manual Door Closer Warranty (10-year)					
08 71 00	Door Hardware: Mortise, Auxiliary, and Bored Locks Warranty (5-year)					
08 71 00	Door Hardware: Exit Device Warranty (5-year)					
08 71 00	Door Hardware: Complete set of specialized tools with maintenance instructions.					
08 91 19	Fixed Louvers: Fluoropolymer Finish on Aluminum Substrates Warranty (20-year)					
09 91 00	Painting: Extra Materials (5%, min. 1-gallon each material and color.)					
09 91 23	Interior Painting: Extra Materials (5%, min. 1-gallon each material and color.)					
21 13 13	Fire Sprinkler Systems: Extra Materials					
21 13 13	Fire Sprinkler Systems: Special Tools					
21 22 00	Clean Agent Fire Extinguishing Systems: Extra Materials					
21 22 00	Clean Agent Fire Extinguishing Systems: Special Tools					
22 30 00 [1]	**Plumbing Equipment: Tepid Water Heater Pressure Vessel Warranty (10-year)**					
23 05 33 [1]	**Heat Tracing for HVAC Piping: Manufacturer Defect Warranty (10-year)**					
23 09 00	Building Automation System: Flow Meter Warranty (2-Year)					
23 21 13	Hydronic Pumps: Extra Materials					
23 21 13	Hydronic Pumps: Special Tools					
23 25 26	Sand Filter System: Extra Materials					
23 25 26	Sand Filter System: Special Tools					

Section	Description	Contractor / Subcontractor	Date Rec'd	# of Copies	CPM Initials	Remarks
23 34 00	HVAC Fans: Extra Materials					
23 34 00	HVAC Fans: Special Tools					
23 51 01 [1]	**Boiler Stack: Materials and Workmanship Warranty (10-year)**					
23 65 14 [1]	**Inducted Draft Cooling Towers: Warranty (10-Year)**					
23 65 14 [1]	**Inducted Draft Cooling Towers: Extra Materials**					
23 65 14 [1]	**Inducted Draft Cooling Towers: Special Tools**					
23 73 00	Indoor Central Station Air Handling Unit: Extra Materials					
23 73 00	Indoor Central Station Air Handling Unit: Special Tools					
23 82 39	Unit Heaters: Extra Materials					
23 82 39	Unit Heaters: Special Tools					
26 05 73	Low Voltage Electrical System Studies: SKM Program					
26 05 73	Low Voltage Electrical System Studies: Arc Flash Labels					
26 24 16	Panelboards: Panel Schedules					
26 29 23	Variable Frequency Motor Controllers: Extra Materials					
26 29 23	Variable Frequency Motor Controllers: Special Tools					
28 31 11	Addressable Fire Alarm System: Maintenance Contract					
40 90 00	Process Automation Control System: Flow Meter Warranty (2-Year)					
40 90 00	Process Automation Control System: Extra Materials					
40 90 00	Process Automation Control System: Special Tools					

END OF SECTION

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SECTION 1.H
ALTERNATES

Base Bid may be increased in accordance with following Additive Alternate proposal(s) as Owner may elect:

Refer to piping and instrumentation diagrams for piping boundary limits of alternates. Add alternate boxes shown on plans and sections for reference.

1. Additive Alternate No. 1 Loop Pump LP-02:

Scope includes: Loop Pump LP-02, pump VFD and disconnects, pipe supports, and 12" CHWS piping from valve 02-HV-401-1 to valve 02-HV-407-2 including indicated fittings, valves, drains, vents, insulation, instrumentation, control devices, and electrical cabling and raceways shown on drawing M-602. Refer to the following plan and section sheets for additional Add Alternate 1 information:

G-002	MP-132	EO-012
GA-132	MP-142	EP-122
GA-142	MP-221	EP-132
GA-221	MP-223	EP-142
GA-223	MP-224	EP-221
GA-224	MP-621	EP-611
GA-225	MS-132	EP-612
S-200	MS-142	EP-613
	MS-621	EC-011
	MI-132	EC-601
	MI-142	
	MI-601	

2. Additive Alternate No. 2 Cooling Tower CT-02 and Tower Pump TP-02:

Scope includes: Cooling Tower Cell CT-02, Cooling Tower Fan CT-02, fan VFD and disconnects, Tower Water Pump TP-02, pump VFD and disconnects, pipe supports, 12"/14" tower water supply piping from valve 02-HV-627-1 to valve 02-HV-627-5 including indicated fittings, valves, drains, vents, basket strainer, insulation, instrumentation, control devices, and electrical cabling and raceways shown on drawing M-611, 10" Tower Water Supply from CT-02 to 10"x16" reducer, 12"/16" tower water equalization line in its entirety from Cooling Tower CT-01 to Cooling Tower CT-02, 10"/14" tower water return from valve 02-HV-537-1 to Cooling Tower CT-02, and 4"/6" tower water drain piping from cooling tower CT-02 including indicated fittings, valves, drains, vents, basket strainer, instrumentation, control devices, and electrical cabling and raceways shown on drawing M-612. Refer to the following plan and section sheets for additional Add Alternate 2 information:

G-002	MP-132	EO-012
GA-100	MP-142	EG-162
GA-132	MP-152	EP-122
GA-142	MP-162	EP-132
GA-162	MP-223	EP-142
GA-223	MP-226	EP-152
GA-225	MP-227	EP-162
GA-226	MP-621	EP-221
GA-227	MS-132	EP-505
S-200	MS-142	EP-602
	MS-152	EP-611
	MS-621	EP-612
	MI-132	EP-613
	MI-142	EC-011
	MI-162	EC-601
	MI-601	
	MI-602	

Cooling tower structure for Cooling Towers CT-01 and CT-02 to be constructed in its entirety in base bid.

3. Additive Alternate No. 3 Chiller CH-02 and Chiller Pump CP-02:

Scope includes: Chiller CH-02, Cooling Tower Fan CF-02, Chiller Pump CP-02, pump vfd and disconnects, pipe supports, 10"/12" chilled water return piping from valve 02-HV-317-1 to Chiller CH-02 and 10"/12" chilled water supply from Chiller CH-02 to valve 02-HV-107-1 including indicated pump, fittings, valves, drains, vents, basket strainer, insulation, instrumentation, control devices, and electrical cabling and raceways shown on drawing M-602, 12"/14" tower water supply from valve 02-HV-127-1 to Chiller CH-02 and 12"/14" tower water return from Chiller CH-02 to valve 02-HV-137-1 including indicated fittings, valves, drains, vents, basket strainer, instrumentation, control devices, and electrical cabling and raceways shown on drawing M-611, 3" refrigerant vent from Chiller CH-02 through wall including flex connectors, fittings, valves, and drain piping as shown on drawing M-641. Refer to the following plan and section sheets for additional Add Alternate 3 information:

G-002	MP-132	EO-012
GA-132	MP-142	EG-132
GA-142	MP-221	EP-122
GA-221	MP-222	EP-132
GA-222	MP-223	EP-142
GA-223	MP-224	EP-221
GA-224	MP-621	EP-602
GA-225	MS-132	EP-611
S-200	MS-142	EP-612
	MS-621	EP-613
	MI-132	EC-011
	MI-142	EC-601
	MI-601	
	MI-602	

END OF SECTION

SECTION 07 41 13-16
STANDING-SEAM METAL ROOF PANELS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Vertical-rib, seamed-joint, standing-seam metal roof panels.
   2. Roof insulation.
   3. Cover board.

B. Related Requirements:
   1. Section 07 72 53 Snow Guards for prefabricated devices designed to hold snow on the roof surface, allowing it to melt and drain off slowly.

1.2 DEFINITIONS

A. Structural Standing-Seam Metal Roof Panel System: A roof system designed to resist positive and negative loads applied normal to the metal roof panel surface without the benefit of a supporting deck or sheathing.

1.3 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

B. Coordinate metal roof panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.4 ACTION SUBMITTALS

A. Product Data:
   1. For standing-seam metal roof panels. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:
   1. Include fabrication and installation layouts of metal roof panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
   2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Initial Selection: Manufacturer's standard color charts, showing full range of available colors for each type of exposed finish.
   i. Include similar Samples of trim and accessories involving color selection.

D. Samples for Verification: Actual sample of finished products for each type of exposed finish for metal roof panels and metal panel accessories.
   1. Size: Manufacturers' standard size

1.5 INFORMATIONAL SUBMITTALS

A. Certificates for portable roll-forming equipment.

B. Product Test Reports: For standing-seam metal roof panels, for tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Qualification Statements: For roof installers.

E. Sample warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal roof panels.

1.7 QUALITY ASSURANCE

A. Roof Installer Qualifications: Entity that employs a supervisor who is an NRCA ProCertified Roofing Foreman or installers who are NRCA ProCertified Metal Panel Roof Systems Installers

B. Portable Roll-Forming Equipment Certification: UL-certified, portable roll-forming equipment capable of producing metal roof panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of Work.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal roof panels, and other manufactured items so as not to be damaged or deformed. Package metal roof panels for protection during transportation and handling.

B. Unload, store, and erect metal roof panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal roof panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal roof panels to ensure dryness, with positive slope for drainage of water. Do not store metal roof panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal roof panels during installation.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal roof panels to be performed in accordance with manufacturers' written installation instructions and warranty requirements.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of metal roof panel systems that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including rupturing, cracking, or puncturing.
      b. Deterioration of metal and other materials beyond normal weathering.
   2. Warranty Period: **Two** years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer agrees to repair finish or replace metal roof panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
   b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: 20 years from date of Substantial Completion.

C. Special Weathertightness Warranty: Manufacturer agrees to repair or replace standing-seam metal roof panel systems that fail to remain weathertight, including leaks, within specified warranty period.
   1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal roof panel systems capable of withstanding the effects of the following loads when tested in accordance with ASTM E1592:
   1. Wind Loads: As indicated on Drawings.
   2. Structural Standing-Seam Steel Roof Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E1514.
   3. Structural Standing-Seam Aluminum Roof Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E1637.

2.2 STANDING-SEAM METAL ROOF PANELS, GENERAL

A. Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with seamed joint type indicated and mechanically attaching panels to supports using concealed fasteners inside laps. Include all accessories required for weathertight installation.

2.3 VERTICAL-RIB, SEAMED-JOINT, STANDING-SEAM METAL ROOF PANELS

A. Manufacturers: Subject to compliance with requirements, provide products by the following or an approved equal:
   1. McElroy Metal, Inc
   2. Berridge Manufacturing Company
   3. CENTRIA, a Nucor Brand
   4. MBCO; Cornerstone Building Brands
   5. PAC-CLAD; Petersen; a Carlisle Company

2.4 METAL ROOF PANEL MATERIAL

A. Basis of Design: 138T by McElroy Metal 1500 Bossier City, LA , or approved substitute, meeting the following requirements.
   1. Requests for approval must be submitted in writing at least ten (10) days prior to bid date, and are accompanied by all related test reports and design calculations listed in Reference section 1.3 and Design and Performance criteria Section 1.7.
   2. Substitute manufactures will be approved written addendum to all bidders. Voluntary alternates will not be considered. Substitutions will not be permitted after the bid date of this project.
   3. Factory-formed panel, width of 16 inches. Panels shall be symmetrical in design and shall be mechanically seamed with a field operated electric seaming machine approved by the manufacturer.

4. Minimum seam height 1 3/8 inches. Integral seam, double lock and snap together type panels are not acceptable
5. Seam cap matching panel finish with two rows of integral factory hot applied sealant.
6. Galvalume steel sheet conforming to ASTM A792, AZ55 coating for bare; AZ50 coating for painted; 24 gauge sheet thickness.
7. Finish: Two coat coil applied, baked-on full-strength (70% resin, PVF2) fluorocarbon coating consisting of a nominal of .25 mil dry film thickness primer, nominal dry film thickness of .75 mil color coat. Finish to be selected from manufacturer's standard color selection. The back side of the material should be .25 mil. Primer and 0.25 polyester wash coat.
8. Roof panel system must allow individual roof panel removal and replacement from any point on the roof without damage to adjacent roof panel(s).
9. Panels must be furnished and installed in continuous lengths from ridge to eave with no overlaps. Panels too long to ship will be manufactured on site using manufacturers employees and equipment.
10. Panel surface characteristics to be chosen by Architect for roof panel manufacturer's available types.
    a. Smooth.
    b. Striations.
    c. Plank
    d. Stiffener ribs
11. Manufacturer watertightness warranty, meeting requirements of this Section.
12. Roof panels proposed for substitution shall fully comply with specified requirements in appearance, assembly, and performance. Substitution request must comply with Division 1 requirements for submission.

2.5 FASTENERS AND ACCESSORIES

A. Panel Clip Screw - screw required in wind uplift rating requirements for application, with corrosion-resistant coating, in length necessary to penetrate metal deck minimum 3/4 inch., as supplied by roof panel manufacturer.

B. Roof Panels Clip:
1. Intermittent Clip: 24 gauge grade 50 coated steel, 2 piece fixed clips minimum 8" long, designed to allow unlimited roof panel thermal movement and not contact roof panel cap, as supplied by roof panel manufacturer, marking meeting wind uplift requirements of this Section.
2. Shingle Recover Clip: 16 gauge galvanized steel, one-piece 8" long clip, designed to sit on two shingle tabs at one time, provide a ¾" ventilated air space between roof deck and roof panels, allow roof panel thermal movement and not contact roof panel cap, as supplied by roof panel manufacturer, meeting wind uplift requirements and design criteria of this section.
3. Intermittent Clip Bearing Plate: in gage, size and finish as supplied by and approved by roof panel manufacturer for use in roof panel manufacturer's full assembly warranted systems.
4. Fiber Reinforced Polycarbonate Shim Plate: used in lieu of bearing plates in areas where deck is uneven to insure level finished panel surface.
5. Multi Span-Continuous Clip: as provided by roof panel manufacturer in edge and corner zones to maximize wind uplift performance and for full assembly warranted systems.

C. Trim and flashing will be of the same gage and finish unless approved otherwise by the metal roof system manufacturer.
1. All sheet metal valleys will be supplied in continuous lengths up to 32'
2. Ridge closures, consisting of metal channel surrounding factory precut closed cell foam, will not be secured through the field of the panel.

3. Trim will be installed specifically as displayed in the manufacturer provided shop drawings. Proposed changes must be approved in writing by the metal roof system manufacturer.

D. Concealed supports, angles, plates, accessories and brackets: in gage and finish as recommended, and furnished by manufacturer.

E. Accessory Screw: Size and screw type as provided by panel manufacturer for each use, with prefinished hex washer head in color to match panels where exposed to view.

F. Rivets: full stainless steel, including mandrel, in size to match application.

G. Field Sealant: Color coordinated primerless silicone, or high grade, non-drying butyl, as supplied by panel manufacturer.

H. Sealant Tape: non-drying, 100 percent solids, high grade butyl tape, as supplied by panel manufacturer, in sizes to match application.

I. Pipe Penetration Flashings: flexible boot type, with stainless steel compression ring, and stainless steel pipe strap, Dektite by Buildex, or approved substitute. Use silicone type at hot pipes.

J. Metal Roof Curbs: welded aluminum, or stainless steel, factory-insulated, with integral cricket, and designed to fit roof panel module, sized to meet application, by L.M. Curbs, or approved substitute.

2.6 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C645; cold-formed, metallic-coated steel sheet, minimum ASTM A653/A653M, G90 hot-dip galvanized coating designation or ASTM A792/A792M, Class AZ50 coating designation. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Roof Panel Accessories: Provide components required for a complete, weathertight metal roof panel system including trim, copings, fasciae, mullions, sills, corner units, fasteners, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.
1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal roof panels.
2. Backing Plates: Provide metal backing plates at roof panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal roof panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal roof panels.

D. Gutters: Formed from same material as metal roof panels, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- long sections, of size and metal thickness in accordance with manufacturer's recommendations. Furnish gutter supports spaced a maximum of 36 inches o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match metal roof panels.

E. Downspouts: Formed from same material as metal roof panels. Fabricate in 10 ft. long sections, complete with formed elbows and offsets, of size and metal thickness in accordance with manufacturer's recommendations. Finish downspouts to match gutters.

F. Roof Panel Fasteners: Self-tapping screws designed to withstand design loads.

2.7 FABRICATION

A. Fabricate and finish metal roof panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. On-site Fabrication: Subject to compliance with requirements of this Section, metal roof panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate in accordance with equipment manufacturer's written instructions and to comply with details shown.

C. Provide roof panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

D. Fabricate metal roof panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations that apply to design, dimensions, metal, and other characteristics of item indicated.
   1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
   2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
   3. Seams for other than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
   4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with manufacturer's recommendations.
   5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not permitted on faces of accessories exposed to view.
   6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal roof panel manufacturer.
      a. Size: As recommended by metal roof panel manufacturer for application, but not less than thickness of metal being secured.

2.8 FINISHES

A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal roof panel supports, and other conditions affecting performance of the Work.
   1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
   2. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
      a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal roof panels to verify actual locations of penetrations relative to seam locations of metal roof panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages in accordance with ASTM C754 and metal roof panel manufacturer's written installation instructions.

3.3 INSTALLATION OF ROOF INSULATION

A. General: Install insulation concurrently with metal roof panel installation, in thickness indicated to cover entire surface, in accordance with manufacturer's written installation instructions.
   1. Set vapor-retarder-faced units with vapor retarder toward warm side of construction unless otherwise indicated. Do not obstruct ventilation spaces except for firestopping.
   2. Tape joints and ruptures in vapor retarder and seal each continuous area of insulation to the surrounding construction to ensure airtight installation.

B. Blanket Roof Insulation: Comply with the following installation method:
   1. Over-Framing Installation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Hold in place by metal roof panels fastened to secondary framing.
   2. Between-Purlin Installation: Extend insulation and vapor retarder between purlins. Carry vapor-retarder-facing tabs up and over purlin, overlapping adjoining facing of next insulation course and maintaining continuity of retarder. Hold in place with bands and crossbands below insulation.

3.4 INSTALLATION OF COVER BOARD

A. Install cover board over insulation in accordance with manufacturer's written installation instructions. Install with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction.

3.5 INSTALLATION OF STANDING-SEAM METAL ROOF PANELS

A. Install metal roof panels in accordance with manufacturer's written installation instructions and approved Shop Drawings in orientation, sizes, and locations indicated. Anchor metal roof panels

and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal roof panels.
2. Flash and seal metal roof panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal roof panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal roof panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal roof panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:
1. Steel Roof Panels: Use stainless steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
2. Aluminum Roof Panels: Use aluminum or stainless steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
3. Stainless Steel Roof Panels: Use stainless steel fasteners.
4. Copper Roof Panels: Use copper, stainless steel, or hardware-bronze fasteners.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal roof panel manufacturer.

D. Concealed Clip, Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.
1. Install clips to supports with self-tapping fasteners.
2. Install pressure plates at locations indicated in manufacturer's written installation instructions.

E. Roof Panel Joints: Fasten panel joints to substrate in accordance with manufacturer's instructions.
1. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
2. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
3. Watertight Installation:
   a. Apply a continuous ribbon of sealant or tape to seal joints of metal roof panels, using sealant or tape as recommended in writing by manufacturer as needed to make panels watertight.
   b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
   c. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.

F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete metal roof panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal roof panel manufacturers; or, if not indicated, types recommended by metal roof panel manufacturer.

G. Flashing and Trim: Comply with performance requirements and manufacturer's written installation instructions. Provide concealed fasteners where possible and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
   1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof and weather-resistant performance.
   2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 ft. with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

H. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.

I. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.
   1. Provide elbows at base of downspouts to direct water away from building.
   2. Connect downspouts to underground drainage system indicated.

J. Roof Curbs: Install curbs at locations indicated on Drawings. Install flashing around bases where they meet metal roof panels.

K. Pipe and Conduit Penetrations: Fasten and seal to metal roof panels as recommended by manufacturer.

3.6 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal roof panels within installed tolerance of 1/4 inch in 20 ft. on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.7 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect metal roof panel installation, including accessories. Report results in writing.

B. Remove and replace applications of metal roof panels where tests and inspections indicate that they do not comply with specified requirements.

C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

D. Prepare test and inspection reports.

3.8 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal roof panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On

completion of metal roof panel installation, clean finished surfaces as recommended by metal roof panel manufacturer. Maintain in a clean condition during construction.

B. Replace metal roof panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures

END OF SECTION

SECTION 07 54 23
THERMOPLASTIC-POLYOLEFIN (TPO) ROOFING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Thermoplastic polyolefin (TPO) roofing system.
2. Accessory roofing system materials.
3. Roof insulation and accessories.

B. Section contains the installation of sound-absorbing insulation strips in ribs of acoustical steel roof deck. Sound-absorbing insulation strips are furnished under Section 05 31 00 Steel Decking.

C. Related Requirements:
1. Section 07 62 00 Sheet Metal Flashing and Trim for metal roof flashing and counterflashing.

1.2 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D1079 and glossary in NRCA's " Roofing Manual: Membrane Roof Systems" apply to Work of this Section.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:
1. Layout and thickness of insulation.
2. Base and sheet flashings and membrane termination details.
3. Flashing details at penetrations.
4. Tapered insulation layout, thickness, and slopes.
5. Roof plan showing orientation of roof deck and orientation of roofing membrane, fastening spacings, and pattern for corner, perimeter, and field-of-roof locations.
6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
7. Crickets, saddles, and tapered edge strips, including slopes.
8. Tie-in with adjoining wall system air barrier.

C. Samples for Verification: For the following products:
1. Roofing membrane and flashings, of color required.

D. Wind-Uplift-Resistance: For roofing system indicating compliance with wind-uplift performance requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer Certificates:
1. Performance Requirement Certificate: Signed by roofing membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
a. Submit evidence of compliance with specified performance requirements.
2. Special Warranty Certificate: Signed by roofing membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

B. Source Quality Control Test Reports: For roofing membrane and insulation, tests performed by an independent qualified testing agency indicating compliance with specified requirements.

C. Field Quality Control Test Reports:
1. Concrete internal relative humidity test reports.
2. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.

D. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system.

B. Certified statement from existing roofing system manufacturer stating that existing roof warranty has not been affected by the Work performed under this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm that is approved, authorized, certified, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing system materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer.
1. Protect stored liquid material from direct sunlight.
2. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources.
1. Store in a dry location.
2. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing system materials, and place equipment in a manner to avoid permanent deflection of deck.

1.8 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed in accordance with manufacturer's written installation instructions and warranty requirements.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
1. Special warranty to include all components of roofing system, such as vapor retarder, roof insulation, fasteners, adhesives, roofing membrane, base flashing sheet, and other components of roofing system.

2. Warranty Period: 20 years from date of Substantial Completion.

B. Roofing System Installer's Warranty: Submit Roofing System Installer's warranty, on warranty form at end of this Section, signed by Roofing System Installer, covering the Work of this Section, including all components of roofing system, such as vapor retarder, roof insulation, fasteners, adhesives, roofing membrane, base flashing sheet, and other components of roofing system.
1. Warranty Period: Two years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain components for roofing system from manufacturer approved by roofing membrane manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Material Compatibility: Roofing system materials to be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roofing membrane manufacturer based on testing and field experience.

2.3 THERMOPLASTIC POLYOLEFIN (TPO) ROOFING SYSTEM

A. TPO Roofing Membrane Sheet: ASTM D6878/D6878M, internally fabric- or scrim-reinforced, self-adhering TPO sheet.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
a. Carlisle Syntec Systems
b. Cooley Group
c. Custom Seal Inc.
d. Elevate; Holcim Building Envelope
e. Flex Membrane International Corp.
f. GAF
g. GenFlex Roofing Systems
h. IKO Innovi; IKO Industries Inc.
i. Johns Manville; a Berkshire Hathaway company
j. Mule-Hide Products Co., Inc
k. Siplast
l. Versico Roofing Systems; Carlisle Construction Materials
2. Thickness: 60 mil, nominal.
3. Exposed Face Color: White.

2.4 ACCESSORY ROOFING SYSTEM MATERIALS

A. General: Accessory materials as recommended in writing by roofing membrane manufacturer for intended use and compatible with other roofing system components.
1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.
a. Plastic Foam Adhesives: 50 g/L.
b. Gypsum Board and Panel Adhesives: 50 g/L.
c. Multipurpose Construction Adhesives: 70 g/L.
d. Fiberglass Adhesives: 80 g/L.
e. Contact Adhesives: 80 g/L.
f. PVC Welding Compounds: 510 g/L.
g. Other Adhesives: 250 g/L.
h. Single-Ply Roof Membrane Sealants: 450 g/L.
i. Nonmembrane Roof Sealants: 300 g/L.

j. Sealant Primers for Nonporous Substrates: 250 g/L.
k. Sealant Primers for Porous Substrates: 775 g/L.

B. Base and Sheet Flashings: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as roofing membrane.

C. Prefabricated Pipe Flashings: As recommended in writing by roofing membrane manufacturer.

D. Roof Vents: As recommended in writing by roofing membrane manufacturer.
1. Size: Not less than 4-inch diameter.

E. Bonding Adhesive: Roofing membrane manufacturer's standard, water based.

F. Slip Sheet: Manufacturer's standard, of thickness required for application.

G. Asphalt-Coated, Glass-Fiber-Mat, Venting Base Sheet: ASTM D4897/D4897M, Type II; nonperforated, asphalt impregnated, fiberglass reinforced, with mineral granular patterned surfacing on bottom surface.

H. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.

I. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing system components to substrate; tested for required pullout strength, and acceptable to roofing membrane manufacturer.

J. Safety Accessories: Roofing membrane manufacturer's standard yellow seaming tape for designating safety perimeters and rooftop hazards.

K. Miscellaneous Accessories: As recommended in writing by roofing membrane manufacturer.

2.5 VAPOR RETARDER

A. Rubberized-Asphalt-Sheet Vapor Retarder, Self-Adhering: ASTM D1970/D1970M, polyethylene film laminated to layer of rubberized asphalt adhesive, minimum 40-mil total thickness; maximum permeance rating of 0.1 perm; cold applied, with slip-resisting surface and release paper backing. Provide primer when recommended by vapor retarder manufacturer.

B. Butyl-Rubber-Sheet Vapor Retarder, Self-Adhering: Polyethylene film laminated to layer of butyl rubber adhesive, minimum 30-mil total thickness; maximum permeance rating of 0.1 perm; cold applied, with slip-resisting surface and release paper backing. Provide primer when recommended by vapor retarder manufacturer.

2.6 ROOF INSULATION AND ACCESSORIES

A. General: Preformed roof insulation boards manufactured or approved by roofing membrane manufacturer, approved for use in listed roof assemblies.

B. Extruded-Polystyrene Board Insulation: ASTM C578, Type V, 3.00 lb/cu. ft., minimum density, 100 psi minimum compressive strength, square edged.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
a. DuPont
b. Kingspan Insulation LLC
c. Owens Corning

d. Soprema, Inc.

2. Thermal Resistance: R-value of 5.0 per 1 inch.
3. Size: 48 by 48 inches.
4. Thickness:
   a. Base Layer: 3 inches.
   b. Upper Layer: 1-1/2 inches.

C. Tapered Insulation: Provide factory-tapered insulation boards.
1. Material: Match roof insulation.
2. Minimum Thickness: 1/4 inch.
3. Slope:
   a. Roof Field: 1/4 inch per foot unless otherwise indicated on Drawings.
   b. Saddles and Crickets: 1/2 inch per foot unless otherwise indicated on Drawings.

D. Roof Insulation Accessories, General: As recommended in writing by insulation manufacturer for intended use and compatibility with other roofing system components.
1. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate and to another insulation layer as follows:
   a. Modified asphaltic, asbestos-free, cold-applied adhesive.
   b. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
   c. Full-spread, spray-applied, low-rise, two-component urethane adhesive.
2. Verify adhesives and sealants comply with the following limits for VOC content:
   a. Plastic Foam Adhesives: 50 g/L.
   b. Gypsum Board and Panel Adhesives: 50 g/L.
   c. Multipurpose Construction Adhesives: 70 g/L.
   d. Fiberglass Adhesives: 80 g/L.
   e. Contact Adhesives: 80 g/L.
   f. PVC Welding Compounds: 510 g/L.
   g. Other Adhesives: 250 g/L.
   h. Single-Ply Roof Membrane Sealants: 450 g/L.
   i. Nonmembrane Roof Sealants: 300 g/L.
   j. Sealant Primers for Nonporous Substrates: 250 g/L.
   k. Sealant Primers for Porous Substrates: 775 g/L.
3. Insulation Fasteners: Insulation manufacturer's standard factory-coated steel fasteners with metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

2.7 COVER BOARD

A. General: Cover board as recommended in writing by roofing membrane manufacturer for intended use and compatible with other roofing system components.

B. Cellulosic-Fiber Insulation Cover Board: ASTM C208, Type II, Grade 2, high-density cellulosic-fiber insulation board, having a minimum compressive strength of 40 psi.
1. Thickness: 1/2 inch.
2. Surface Finish: Primed one side.

C. High-Density Polyisocyanurate Cover Board: ASTM C1289 Type II, Class 4, Grade 1, 1 inch thick, with a minimum compressive strength of 80 psi.

D. Protection Mat: Woven or nonwoven polypropylene, polyolefin, or polyester fabric; water permeable and resistant to UV degradation; type and weight as recommended in writing by roofing system manufacturer for application.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Roofing System Installer present, for compliance with requirements and other conditions affecting performance of the Work.
   1. Verify that concrete substrate is visibly dry and free of moisture, and that minimum concrete internal relative humidity is not more than 75 percent, or as recommended by roofing system manufacturer, when tested in accordance with ASTM F2170.
      a. Test Frequency: One test probe per each 1000 sq. ft., or portion thereof, of roof deck, with not less than three tests probes.
      b. Submit test reports within 24 hours after performing tests.
   2. Verify that concrete-curing compounds that will impair adhesion of roofing components to roof deck have been removed.
   3. Verify that joints in precast concrete roof decks have been grouted flush with top of concrete.
   4. Verify that minimum curing period recommended by roofing system manufacturer for lightweight insulating concrete roof decks has passed.
   5. Verify any damaged sections of cementitious wood-fiber decks have been repaired or replaced.
   6. Verify adjacent cementitious wood-fiber panels are vertically aligned to within 1/8 inch at top surface.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing system installation in accordance with roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. Prime surface of concrete deck with primer in accordance with roofing system manufacturer's written installation instructions and allow primer to dry.

D. Perform fastener-pullout tests in accordance with roofing system manufacturer's written instructions.
   1. Submit test result within 24 hours after performing tests.
      a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

E. Install sound-absorbing insulation strips in ribs of acoustical steel roof deck in accordance with roof deck manufacturer's written instructions.

3.3 INSTALLATION OF THERMOPLASTIC-POLYOLEFIN (TPO) ROOFING SYSTEM, GENERAL

A. Install roofing system materials and components in accordance with roofing system manufacturer's written installation instructions, listed roof assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.

B. Substrate-Joint Penetrations: Prevent adhesives from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

3.4 INSTALLATION OF ROOF INSULATION AND ACCESSORIES

A. Coordinate installation of roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.

B. Comply with roofing system and insulation manufacturer's written installation instructions. Install minimum of two layers of insulation under area of roofing to achieve required thickness.

C. Install each layer of insulation with joints staggered not less than 24 inches in adjacent rows and offset not less than 12 inches from previous layer.
1. Trim insulation neatly to fit around penetrations and projections, and to fit tightly to intersecting sloping roof decks.
2. Make joints between adjacent insulation boards not more than 1/4 inch in width.
3. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches.
4. Trim insulation, so that water flow is unrestricted.
5. Fill gaps exceeding 1/4 inch with insulation.
6. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
7. Secure insulation to resist specified uplift pressure at corners, perimeter, and field of roof.
8. Place thermal spacers and plates on insulation in required fastening patterns and secure in accordance with manufacturer's instructions.
   a. Install plates and fasteners tight and flat to substrate with no dimpling, and with fastener extending 1 inch minimum into roof deck; do not overdrive fasteners.
9. Loosely lay each layer of insulation over substrate.

3.5 INSTALLATION OF TPO ROOFING MEMBRANE

A. Install roofing membrane over roof area for adhered application method in accordance with roofing system manufacturer's written installation instructions.

B. Unroll roofing membrane and allow it to relax before installing.

C. Start installation in presence of roofing system manufacturer's technical personnel.

D. Accurately align roofing membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps. Apply roofing membrane with side laps shingled with slope of roof deck where possible.

E. Adhered Application: Apply bonding adhesive to substrate and underside of roofing membrane at rate required by manufacturer and allow to partially dry before installing roofing membrane. Do not apply to splice area of roofing membrane.
1. In addition to adhering, mechanically fasten roofing membrane securely at terminations, penetrations, and perimeter of roof area.

F. Seams and End Laps: Clean seam areas, overlap membrane, and hot-air-weld side seams and end laps of roofing membrane and sheet flashings to ensure a watertight installation.
1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roofing membrane and sheet flashings.
2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roofing membrane that do not comply with requirements.

G. Spread sealant bed over deck-drain flange at roof drains, and securely seal roofing membrane in place with clamping ring.

3.6 INSTALLATION OF BASE AND SHEET FLASHINGS

A. General: Install and adhere base and sheet flashing and preformed flashing accessories to substrates in accordance with roofing system manufacturer's written installation instructions.

B. Apply bonding adhesive to substrate and underside of flashings at required rate and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners.

D. Clean seam areas, overlap, and firmly roll flashings into the adhesive. Hot-air-weld side seams and end laps to ensure a watertight installation.

E. Terminate and seal top of flashings and mechanically anchor to substrate through termination bars.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspect substrate conditions, surface preparation, and installation of roofing membrane, flashings, protection, and drainage components, and to furnish reports to Architect.

B. Perform the following tests:

C. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.
1. Notify Architect and Owner 48 hours in advance of date and time of inspection.

D. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.8 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing system, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

SECTION 07 62 00
SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Custom flashing and trim fabrications, made from the following:
   1. Sheet metal materials.
   2. Underlayment.
   3. Miscellaneous materials.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For sheet metal flashing and trim.
   1. Plans, elevations, sections, and attachment details.
   2. Fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
   3. Identification of material, thickness, weight, and finish for each item and location in Project.
   4. Details for forming, including profiles, shapes, seams, and dimensions.
   5. Details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
   6. Details of termination points and assemblies.
   7. Details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
   8. Details of roof-penetration flashing.
   9. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counterflashings.
   10. Details of special conditions.
   11. Details of connections to adjoining work.
   12. Formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Initial Selection:
   1. For each exposed product and for each color and texture specified, 12 inches long by actual width.
   2. Manufacturer's standard color sheets, showing full range of available colors for each type of exposed finish.

D. Samples for Verification:
   1. Actual sample of finished products for each type of exposed finish for sheet metal and other metal accessories.
   2. Sheet Metal Flashing and Trim: Manufacturers' standard size. Include finished seam with required profile. Include fasteners, cleats, clips, closures, and other attachments.

1.3 INFORMATIONAL SUBMITTALS

A. Certificates: For each type of coping and roof edge flashing that is ANSI/SPRI/FM 4435/ES-1 tested.

B. Source Quality Control Test Reports: For each product, for tests performed by a qualified testing agency.

C. Field Quality Control Reports: For copings and roof edge flashing, from an agency acceptable to authority having jurisdiction showing compliance with ANSI/SPRI/FM 4435/ES-1.

D. Qualification Statements: For fabricator.

E. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sheet metal flashing and trim, and its accessories.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Entity that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

B. For roof edge flashings and copings that are ANSI/SPRI/FM 4435/ES-1 tested, shop is to be listed as able to fabricate required details as tested and approved.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.
1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
2. Protect stored sheet metal flashing and trim from contact with water.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.7 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.8 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

B. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, are to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in

construction. Completed sheet metal flashing and trim are not to rattle, leak, or loosen, and are to remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. SPRI Wind Design Standard: Manufacture and install roof edge flashings and copings tested in accordance with ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressure:
1. Design Pressure: As indicated on Drawings.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SHEET METAL MATERIALS

A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with minimum ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with minimum ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
1. Nominal Thickness: 0.034 inch.
2. Surface: Smooth, flat.
3. Color: As selected by Architect from manufacturer's full range.
4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

2.3 UNDERLAYMENT

A. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. minimum, of type required for application.

2.4 MISCELLANEOUS MATERIALS

A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.
1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
   a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
   b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.
   c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
2. Fasteners for Zinc-Coated (Galvanized) or Aluminum-Zinc Alloy-Coated Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329/F2329M.

C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

D. Elastomeric Sealant: ASTM C920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

2.5 FABRICATION, GENERAL

A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.
1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances:
1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 ft. on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

F. Seams:
1. Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.

G. Do not use graphite pencils to mark metal surfaces.

2.6 ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Downspouts: Fabricate rectangular downspouts to dimensions indicated on Drawings, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors.
1. Fabricate from the following materials:
a. Galvanized Steel: 0.022 inch thick.

B. Parapet Scuppers: Fabricate scuppers to dimensions required, with closure flange trim to exterior, 4-inch- wide wall flanges to interior, and base extending 4 inches beyond cant or tapered strip into field of roof. Fabricate from the following materials:
   1. Galvanized Steel: 0.028 inch thick.

2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Roof Edge Flashing (Gravel Stop) and Fascia Cap: Fabricate in minimum 96-inch- long, but not exceeding 12 ft. long sections. Furnish with 6-inch- wide, joint cover plates. Shop fabricate interior and exterior corners.
   1. Joint Style: Overlapped, 4 inches wide.
   2. Fabricate with scuppers spaced per drawings , to dimensions required with 4-inch- wide flanges and base extending 4 inches beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scupper.
   3. Fabricate from the following materials:
      a. Galvanized Steel: 0.028 inch thick.

B. Copings: Fabricate in minimum 96-inch- long, but not exceeding 12 ft.- long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and interior leg. Miter corners, fasten and seal watertight.
   1. Joint Style: Butted with expansion space and 6-inch- wide, exposed cover plate.
   2. Fabricate from the following materials:
      a. Galvanized Steel: 0.040 inch thick.

C. Expansion-Joint Cover: Shop fabricate interior and exterior corners.Fabricate roof-to-wall transition expansion-joint cover from the following materials:
   1. Galvanized Steel: 0.034 inch thick.

D. Base Flashing: Shop fabricate interior and exterior corners.Fabricate from the following materials:
   1. Galvanized Steel: 0.028 inch thick.

E. Counterflashing: Shop fabricate interior and exterior corners.Fabricate from the following materials:
   1. Galvanized Steel: 0.022 inch thick.

F. Flashing Receivers: Fabricate from the following materials:
   1. Galvanized Steel: 0.022 inch thick.

G. Roof-Penetration Flashing: Fabricate from the following materials:
   1. Galvanized Steel: 0.028 inch thick.

H. Roof-Drain Flashing: Fabricate from the following materials:
   1. Stainless Steel: 0.0156 inch thick.

2.8 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

A. Apron, Step, Cricket, and Backer Flashing: Fabricate from the following materials:
   1. Galvanized Steel: 0.022 inch thick.

B. Valley Flashing: Fabricate from the following materials:
   1. Galvanized Steel: 0.028 inch thick.

C. Drip Edges: Fabricate from the following materials:
   1. Galvanized Steel: 0.022 inch thick.

D. Eave, Rake, Ridge, and Hip Flashing: Fabricate from the following materials:
   1. Galvanized Steel: 0.022 inch thick.

E. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
   1. Galvanized Steel: 0.022 inch thick.

F. Flashing Receivers: Fabricate from the following materials:
   1. Galvanized Steel: 0.022 inch thick.

G. Roof-Penetration Flashing: Fabricate from the following materials:
   1. Galvanized Steel: 0.028 inch thick.

2.9 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- long, but not exceeding 12 ft. long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings; and form with 2-inch- high, end dams. Fabricate from the following materials:
   1. Stainless Steel: 0.0156 inch thick.

B. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch- high, end dams. Fabricate from the following materials:
   1. Galvanized Steel: 0.022 inch thick.

C. Wall Expansion-Joint Cover: Fabricate from the following materials:
   1. Galvanized Steel: 0.028 inch thick.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrates, and other conditions affecting performance of the Work.
   1. Verify compliance with requirements for installation tolerances of substrates.
   2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
   3. Verify that air- or water-resistant barriers have been installed over substrate to prevent air infiltration or water penetration.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF SHEET METAL FLASHING AND TRIM, GENERAL

A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.
   1. Install fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
   2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of sealant .
   3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
   4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
   5. Install continuous cleats with fasteners spaced not more than 12 inches o.c.
   6. Space individual cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.

7. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
8. Do not field cut sheet metal flashing and trim by torch.
9. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
1. Coat concealed side of uncoated-aluminum and stainless steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
1. Space movement joints at maximum of 10 ft. with no joints within 24 inches of corner or intersection.
2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
3. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction.
1. Use sealant-filled joints unless otherwise indicated.
a. Embed hooked flanges of joint members not less than 1 inch into sealant.
b. Form joints to completely conceal sealant.
c. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way.
d. Adjust setting proportionately for installation at higher ambient temperatures.
i. Do not install sealant-type joints at temperatures below 40 deg F.
2. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 Joint Sealant.

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter.
1. Pretin edges of sheets with solder to width of 1-1/2 inches; however, reduce pretinning where pretinned surface would show in completed Work.
2. Do not pretin zinc-tin alloy-coated copper.
3. Do not use torches for soldering.
4. Heat surfaces to receive solder, and flow solder into joint.
a. Fill joint completely.
b. Completely remove flux and spatter from exposed surfaces.
5. Stainless Steel Soldering:
a. Tin edges of uncoated sheets, using solder for stainless steel and acid flux.
b. Promptly remove acid-flux residue from metal after tinning and soldering.
c. Comply with solder manufacturer's recommended methods for cleaning and neutralization.

H. Rivets: Rivet joints in uncoated zinc where necessary for strength.

3.3 INSTALLATION OF ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Install sheet metal roof-drainage items to produce complete roof-drainage system in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

B. Downspouts:
1. Join sections with 1-1/2-inch telescoping joints.
2. Provide hangers with fasteners designed to hold downspouts securely to walls.
3. Locate hangers at top and bottom and at approximately 60 inches o.c.
4. Provide elbows at base of downspout to direct water away from building.
5. Connect downspouts to underground drainage system.

C. Parapet Scuppers:
1. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
2. Anchor scupper closure trim flange to exterior wall and seal with elastomeric sealant to scupper.
3. Loosely lock front edge of scupper with conductor head.
4. Solder or seal with elastomeric sealant exterior wall scupper flanges into back of conductor head.

D. Conductor Heads: Anchor securely to wall, with elevation of conductor head rim at minimum of 1 inch below scupper or gutter discharge.

E. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated on Drawings. Lap joints minimum of 4 inches in direction of water flow.

3.4 INSTALLATION OF SLOPED ROOF SHEET METAL FABRICATIONS

A. Install sheet metal flashing and trim to comply with performance requirements , sheet metal manufacturer's written installation instructions, and cited sheet metal standard.
1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Edge Flashing:
1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
2. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at 3-inch centers.
3. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for FM Approvals' listing for required windstorm classification.

C. Copings:
1. Install copings in accordance with ANSI/SPRI/FM 4435/ES-1.
2. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated.
   a. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 16-inch centers.
   b. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch centers.
3. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for specified FM Approvals' listing for required windstorm classification.

D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless steel draw band and tighten.

E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.
1. Insert counterflashing in reglets or receivers and fit tightly to base flashing.
2. Extend counterflashing 4 inches over base flashing.
3. Lap counterflashing joints minimum of 4 inches.
4. Secure in waterproof manner by means of snap-in installation and sealant or blind rivets and sealant anchor and washer spaced at 12 inches o.c. along perimeter and 6 inches o.c. at corners areas unless otherwise indicated.

F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric butyl sealant and clamp flashing to pipes that penetrate roof.

3.5 INSTALLATION OF WALL SHEET METAL FABRICATIONS

A. Install sheet metal wall flashing to intercept and exclude penetrating moisture in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings.

3.6 INSTALLATION OF MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing:
1. Coordinate installation of equipment support flashing with installation of roofing and equipment.
2. Weld or seal flashing with elastomeric sealant to equipment support member.

B. Overhead-Piping Safety Pans:
1. Suspend pans from structure above, independent of other overhead items such as equipment, piping, and conduit, unless otherwise indicated on Drawings.
2. Pipe and install drain line to plumbing waste or drainage system.

3.7 INSTALLATION TOLERANCES

A. Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 ft. on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.8 CLEANING

A. Clean and neutralize flux materials. Clean off excess solder.

B. Clean off excess sealants.

3.9 PROTECTION

A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended in writing by sheet metal flashing and trim manufacturer.

C. Maintain sheet metal flashing and trim in clean condition during construction.

D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION

SECTION 07 72 53
SNOW GUARDS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:
   1. Rail-type, seam-mounted snow guards.

1.2 ACTION SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
   1. Rail-type, seam-mounted snow guards.

B. Shop Drawings: Include roof plans showing layouts and attachment details of snow guards.
   1. Include details of rail-type snow guards.

C. Samples:
   1. Rail-Type Snow Guards: Bracket, 12-inch- long rail, and installation hardware.
      a. For units with factory-applied finishes, submit specific color to match roof finish.

1.3 INFORMATIONAL SUBMITTALS

A. Source Quality Control Test Reports: For each type of snow guard, for tests performed by a qualified testing agency, indicating load at failure of attachment to roof system identical to roof system used on this Project.

1.4 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit adhesive-mounted snow guards to be installed, and adhesive cured, according to adhesive manufacturer's written instructions.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Performance Requirements: Provide snow guards that withstand exposure to weather and resist thermally induced movement without failure, rattling, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
   1. Temperature Change: 180 deg F

B. Structural Performance: Snow guards to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
   1. Snow Loads: As indicated on Drawings

2.2 RAIL-TYPE SNOW GUARDS

A. Rail-Type, Seam-Mounted Snow Guards:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Alpine SnowGuards.
      b. Berger; division of OmniMax International, Inc.

c. IceBlox Inc.
d. LMCurbs.
e. PMC Industries, Inc.
f. Rocky Mountain Snow Guards, Inc.
g. S-5! Metal Roof Innovations, Ltd.
h. TRA Snow and Sun, Inc.

2. Description: Snow guard rails fabricated from metal pipes, bars, or extrusions, anchored to brackets and equipped with one rail.
3. Brackets and Baseplate: ASTM B209 aluminum; mill finished
4. Bars: ASTM B221 aluminum; mill finish
   a. Profile: Round
5. Seam Clamps: ASTM B221 aluminum extrusion or ASTM B85/B85M aluminum casting with stainless steel set screws incorporating round nonpenetrating point; designed for use with applicable roofing system to which clamp is attached.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, snow guard attachment, and other conditions affecting performance of the Work.
   1. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean and prepare substrates for bonding snow guards.

B. Prime substrates according to snow guard manufacturer's written instructions.

3.3 INSTALLATION

A. Install snow guards according to manufacturer's written instructions.
   1. Space rows as recommended by manufacturer.

B. Attachment for Asphalt Shingle Roofing:
   1. Rail-Type, Flat-Mounted, Snow Guards: Mounting plates bolted or screwed to the roof framing or roof deck.

C. Attachment for Wood Shingle and Shake Roofing:
   1. Rail-Type, Flat-Mounted Snow Guards: Mounting plates bolted or screwed to the roof framing or roof deck

D. Attachment for Standing-Seam Metal Roofing:
   1. Do not use fasteners that will penetrate metal roofing or fastening methods that void metal roofing finish warranty.
   2. Rail-Type, Seam-Mounted Snow Guards:
      a. Install brackets to vertical ribs in straight rows.
      b. Secure with stainless steel set screws, incorporating round nonpenetrating point, on same side of standing seam.
      c. Torque set screw in accordance with manufacturer's written instructions.
      d. Install cross members to brackets.

E. Attachment for Exposed Fastened Metal Roofing:
   1. Do not use fasteners that will void metal roofing finish warranty.
   2. Rail-Type, Flat-Mounted Snow Guards:
      a. Install brackets in straight rows.
      b. Mechanically fasten to metal roofing, using sealant and mechanical fasteners identical to those used to secure metal roofing to substrate.
      c. Install cross members to brackets.

END OF SECTION

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SECTION 07 81 00
APPLIED FIRE PROTECTION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Sprayed fire-resistive materials.

1.2 DEFINITIONS

A. SFRM: Sprayed fire-resistive materials.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Framing plans or schedules, or both, indicating the following:
   1. Extent of applied fire protection for each construction and fire-resistance rating.
   2. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
   3. Minimum applied fire protection material thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
   4. Treatment of sprayed fire-resistive material after application.

1.4 INFORMATIONAL SUBMITTALS

A. Source Quality Control Test Reports:
   1. For each type of applied fire protection material for tests performed by a qualified testing agency.

B. Field Quality-Control Reports: For each type of applied fire protection material.

C. Qualification Statements: For Installer and testing agency.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by applied fire protection material manufacturer as experienced and with sufficient trained staff to install manufacturer's products in accordance with specified requirements.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not apply applied fire protection when ambient or substrate temperature is 44 deg F or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.

B. Ventilation: Ventilate building spaces during and after application of fire protection, providing complete air exchanges in accordance with manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fire protection dries thoroughly.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Assemblies: Provide applied fire protection, including auxiliary materials, in accordance with requirements of each fire-resistance design and manufacturer's written instructions.

B. Fire-Resistance Design: Indicated on Drawings, tested in accordance with ASTM E119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Steel members are to be considered unrestrained unless specifically noted otherwise.
   2. Flat Paints and Coatings: 50 g/L.
   3. Nonflat Paints and Coatings: 50 g/L.
   4. Primers, Sealers, and Undercoaters: 100 g/L.
   5. Low-Emitting Materials: VOC emissions shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
   6. VOC content shall not exceed limits of authorities having jurisdiction and the following:
      a. Flat Coatings: 50 g/L.
      b. Nonflat Coatings: 100 g/L.
      c. Primers, Sealers, and Undercoaters: 100 g/L.

2.2 AUXILIARY MATERIALS

A. Provide auxiliary materials that are compatible with sprayed fire-resistive material and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.

B. Substrate Primers: Primers approved in writing by sprayed fire-resistive material manufacturer and complying with one or both of the following requirements:
   1. Primer and substrate are identical to those tested in required fire-resistance design by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
   2. Primer's bond strength in required fire-resistance design complies with specified bond strength for sprayed fire-resistive material and with requirements in UL's "Product iQ" online directory or in the listings of another qualified testing agency acceptable to authorities having jurisdiction, based on a series of bond tests in accordance with ASTM E736/E736M.

C. Bonding Agent: Product approved in writing by sprayed fire-resistive material manufacturer and complying with requirements in UL's "Product iQ" online directory or in the listings of another qualified testing agency acceptable to authorities having jurisdiction.

D. Metal Lath: Expanded metal lath fabricated from material of weight, configuration, and finish required, in accordance with fire-resistance designs indicated and sprayed fire-resistive material manufacturer's written instructions. Include clips, lathing accessories, corner beads, and other anchorage devices required to attach lath to substrates and to receive sprayed fire-resistive material.

E. Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire-resistance design indicated; approved and provided by sprayed fire-resistive material manufacturer. Include pins and attachment.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and in accordance with each fire-resistance design.
   1. Verify that substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of applied fire protection with substrates under conditions of normal use or fire exposure.
   2. Verify that objects penetrating applied fire protection, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
   3. Verify that substrates receiving applied fire protection are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fire protection application.

B. Verify that concrete work on steel deck is complete before beginning Work.

C. Conduct tests in accordance with sprayed fire-resistive material manufacturer's written instructions to verify that substrates are free of substances capable of interfering with bond.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Cover other work subject to damage from fallout or overspray of applied fire protection materials during application.

B. Clean substrates of substances that could impair bond of applied fire protection.

C. Prime substrates where included in fire-resistance design and where recommended in writing by sprayed fire-resistive material manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive applied fire protection.

D. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of applied fire protection. Remove minor projections and fill voids that would telegraph through applied fire protection after application.

3.3 APPLICATION

A. Construct applied fire protection assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, sealers, topcoats, finishing, and other materials and procedures affecting applied fire protection Work.

B. Comply with sprayed fire-resistive material manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fire protection; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

C. Coordinate application of fire protection with other construction to minimize need to cut or remove applied fire protection.
   1. Do not begin applying fire protection until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.

2. Defer installing ducts, piping, and other items that would interfere with applying fire protection until application of fire protection is completed.

D. Metal Decks:
1. Do not apply fire protection to underside of metal deck substrates until concrete topping, if any, is completed.
2. Do not apply fire protection to underside of metal roof deck until roofing is completed; prohibit roof traffic during application and drying of fire protection.

E. Install auxiliary materials as required, as detailed, and in accordance with fire-resistance design and sprayed fire-resistive material manufacturer's written instructions for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by sprayed fire-resistive material manufacturer.

F. Spray apply fire protection to maximum extent possible. After the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by sprayed fire-resistive material manufacturer.

G. Extend applied fire protection in full thickness over entire area of each substrate to be protected.

H. Install body of applied fire protection in a single course unless otherwise recommended in writing by sprayed fire-resistive material manufacturer.

I. Where sealers are used, apply products that are tinted to differentiate them from applied fire protection over which they are applied.

J. Provide a uniform finish complying with description indicated for each type of applied fire protection material and matching finish approved for required mockups.

K. Cure applied fire protection in accordance with sprayed fire-resistive material manufacturer's written instructions.

L. Do not install enclosing or concealing construction until after applied fire protection has been inspected, tested, and corrections have been made to deficient applications.

M. Finishes: Where indicated, apply fire protection to produce the following finishes:
1. Manufacturer's Standard Finishes: Finish in accordance with manufacturer's written instructions for each finish selected.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
1. Test and inspect as required by the IBC, Subsection 1705.15, "Sprayed Fire-Resistant Materials.

B. Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fire protection for the next area until test results for previously completed applications of fire protection show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.

C. Applied fire protection will be considered defective if it does not pass tests and inspections.
1. Remove and replace applied fire protection that does not pass tests and inspections, and retest.
2. Apply additional applied fire protection, in accordance with manufacturer's written instructions, where test results indicate insufficient thickness, and retest.

3. Prepare test and inspection reports.

3.5 CLEANING

A. Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

3.6 PROTECTION

A. Protect applied fire protection from damage resulting from construction operations or other causes in accordance with manufacturer's and Installer's written instructions, so applied fire protection is without damage or deterioration at time of Substantial Completion.

3.7 REPAIRS

A. As installation of other adjacent construction proceeds, inspect applied fire protection and repair damaged areas due to work of other trades before concealing it with other construction.

B. Repair applied fire protection using same method and materials as original installation or using manufacturer's recommended trowel-applied repair product.

END OF SECTION

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SECTION 22 30 00
PLUMBING EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section includes piping equipment and accessories for plumbing piping systems.
   1. Backflow preventors.
   2. Tepid water heater.
   3. Safety shower with eye wash station.
   4. Sump pumps. (Addendum 2)

B. The work shall include all materials, equipment, and labor required for complete and properly functioning plumbing piping systems.

C. Work shall include furnishing the required hoisting equipment to set all materials and equipment in place.

D. Provide any required scaffolding and transportation associated with Work of this Project.

1.2 REFERENCES

A. The publications listed below form a part of this Specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. Contractor shall comply with all such regulations and standards and shall protect and indemnify the Owner and Design Professional against any claim or liability arising from, or based upon, non-conformance with the regulations during normal service conditions.

C. American National Standard sInstitute (ANSI)
   1. Z358.1 Emergency Eyewash and Shower Standard

D. International Building Code.

1.3 ACTION SUBMITTALS

A. Product Data:
   1. Backflow Preventers:
      a. Catalog cuts showing design and construction.
      b. Pressure and temperature ratings.
      c. Materials of construction.
      d. Strainer basket or liner mesh.
      e. Pressure loss and flow rate data.
   2. Tepid water heater:
      a. Catalog cuts showing design and construction.
      b. Pressure and temperature ratings.
      c. Materials of construction.
      d. Operational data.
   3. Emergency eyewash and shower.
      a. Catalog cuts showing design and construction.
      b. Pressure and temperature ratings.
      c. Materials of construction.
   4. Sump pumps:
      a. Catalog cuts showing design and construction.
      b. Pressure and temperature ratings.

c. Materials of construction.
d. Operational data. (Addendum 2)

1.4 INFORMATIONAL SUBMITTALS

A. Installation instructions.
1. Backflow preventors.
2. Tepid water heater.
3. Emergency eyewash and shower.
4. Sump pumps. (Addendum 2)

B. Source quality control test reports.

1.5 CLOSEOUT SUBMITTALS

A. Operations and maintenance data: Submit operations and maintenance manual for all piping specialties and accessories within this section.

B. Installation and storage information.

C. Field quality test reports.

1.6 QUALITY ASSURANCE

A. Systems shall be comprised of high-quality industrial-class products of manufacturers that are experienced specialists in the required product lines. Manufacturer shall specialize in manufacturing products specified in this section with minimum five (5) years' experience.

B. All work shall be performed in a neat, workmanlike manner in keeping with the highest standards of the craft. Coordinate with Owner's Representative regarding loud work, times, and protection of objects. All work shall be pre-inspected by Contractor prior to inspection final checkout.

C. Multiple units: When two (2) or more units of materials or equipment of the same type or class are required, these units shall be products of one (1) manufacturer.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Protection of piping specialties and accessories:
1. Piping specialties and accessories placed on the job site shall remain in the custody of the Contractor until acceptance, whether or not Owner has reimbursed Contractor for equipment and material. Contractor shall be solely responsible for the protection of such equipment and material against any damage.
2. Accept materials on site in original factory packaging labeled with manufacturer's identification. Protect from weather and construction traffic, dirt, water, chemicals, and other damage by storing in original packaging.
3. Place damaged equipment in first class, new operating condition or replace with the same piping specialties as determined and directed by the Owner's Representative.
4. Protect interiors of new piping specialties and accessories against entry by foreign matter.

B. Exercise care in storage and handling of piping specialties and accessories to be incorporated in Work. Piping specialties shall be delivered to site clean and free of debris with both ends sealed weather tight.

1.8 WARRANTY

A. Packaged tepid water heater: Manufacturer shall warranty all electrical components against defects in workmanship and material for a period of one (1) year from date of start-up, and the pressure vessel for a full ten (10) from date of start-up.

PART 2 PRODUCTS

2.1 BACKFLOW PREVENTERS

A. Backflow preventer:
1. Type: reduced pressure backflow preventer assembly (ASSE 103).
2. Provide backflow preventors with each unit containing strainer, upstream isolation valve, first check valve, relief valve, second check valve, downstream isolation valve, and test cocks.
3. Maximum working pressure: 175 psi.
4. Temperature range: 33°F - 110°F continuous with 140°F intermittent.
5. 150# ASME flanged end connections.
6. Check and relief valve bodies: FDA epoxy-coated cast iron.
7. Seats: Stainless steel.
8. Trim: Stainless steel.
9. Test Cocks: Bronze body ball valve.
10. Provide SentryPlus Alert technology.
11. Provide with integral bronze strainer.
12. Provide air gap for drain connection.

B. Manufacturer – Model:
1. Backflow Preventer: Watts – Series 909 or Zurn/Wilkins.
2. Air Gap: Watts – 909AG Series or Zurn/Wilkins.

2.2 PACKAGED TEPID WATER HEATER

A. General:
1. Type: Factory packaged. ANSI Z358.1 compliant tepid water delivery system.
2. Designed for tepid water delivery to emergency safety shower/face/eyewash fixtures.
3. Packaged system with integrally mounted, factory supplied, calibrated and performance tested, triple redundant thermostatic pressure balanced mixing valve system.
4. UL listed.

B. Tank:
1. Type: Vertical.
2. Pressure rating: 150 psig.
3. Capacity: 120-gallon.
4. Diameter: 30-inches.
5. Material: Carbon Steel.
6. Lining: Seamless Hydrastone cement.
7. Lining thickness: ½ inch minimum to ¾ inch maximum.
8. Piping connections:
   a. Inlet: 1-1/2 inch NPT.
   b. Outlet: 1-1/2 inch NPT.
   c. Material: Copper-silicon / brass.
   d. Insulation: 3 inch polyurethane foam.
9. Outer jacket: Dent resist composite.

C. Heater:
1. Type: Copper sheathed, immersion, electric heating elements.
2. Voltage: 208-Volt, 3ϕ, 60 Hz.
3. Load: 4.5 kW, maximum.

4. Capacity: 120-gallon.
5. Recovery rate: 15 gallons per hour.

D. Control System:
1. Description: Temperature safety system shall consist of a diaphragm-operated valve actuator to ensure a continuous delivery flow of tepid water. The valve shall monitor pressure on both cold and hot water inlets. On loss of cold water pressure, the valve shall "fail safe" to cold and prevent delivery of hot water to avoid scalding. On loss of hot water pressure, the valve shall allow the full ANSI-required flow of cold water to the emergency safety fixture.
2. Alarm contacts:
   a. Flow Alarm.
   b. Temperature low alarm.
   c. Temperature high alarm.
3. Controller: Adjustable immersion temperature controller
4. Control valve: Integral triple redundant thermostatic pressure balanced mixing valve. 5 psid at 20 gpm.
5. High limit temperature switch, set at 190-degrees F, with manual reset.
6. Temperature gauge.
7. Pressure gauge.
8. ASME temperature and pressure relief valve.
9. Automatic air vent.

E. Accessories: Integral seismic attachments.

F. Manufacturer – Model: Hubbell – Model EMV.

2.3 EMERGENCY EYEWASH AND SHOWER

A. General
1. Type: Combination eyewash shower.
2. ANSI 358.1 and OSHA compliant.
3. Height: 94 ¾ inches.
4. Water connections: 1-14 inch NPT.
5. Stainless steel construction including pipes, valves, bowl, shower head, and eye wash spray heads.
6. Emergency sign and inspection tag.

B. Eyewash:
1. Two spray heads.
2. Flow rate: 3 gpm.
3. Working pressure: 30 to 115 psi.
4. Material: Stainless steel.
5. Bowl dust cover.

C. Shower head:
1. Flow rate: 20 gpm.
2. Working pressure: 30 to 115 psi.
3. Material: Stainless steel.

D. Manufacturer: Uline – H-10735.

2.4 **DUPLEX SUMP PUMP**

A. Refer to equipment schedule on Drawing P-621. (Addendum 2)

PART 3 EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Provide permanent supports for equipment installed under this Contract as indicated on Drawings and as needed for secure and vibration-free operation.

B. Remove all temporary coatings, wrappings, lifting lugs, etc. from equipment. Provide touch-up paint as needed to match manufacturer finish.

C. Contractor shall complete equipment alignment for equipment provided under this Contract and prior to initial operation. Manufacturer’s Representative shall be present during alignment.

D. Check alignment after ductwork connections have been made but before supply and exhaust fans are operated and verify alignment through hot run.

E. Contractor shall provide labor and materials to completely rotate equipment within manufacturer’s required tolerances and to satisfaction of Commissioning Authority.

3.1 INSTALLATION – BACKFLOW PREVENTERS

A. Install in accessible location, no more than 4 feet above the top of finished floor.

B. Install relief drain piping with air gap to floor drain

C. Test and certify backflow preventer by an ASSE-licensed tester.

3.2 INSTALLATION – PACKAGED TEPID WATER HEATER

A. Install electric, tempered water skids level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

B. Install commercial, electric, tempered water skids with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified in Section 22 05 48 - Vibration and Seismic Controls for Plumbing.

C. Extend temperature and pressure relief valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

D. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains.

E. Fill electric, tempered water skids with water.

3.3 FIELD QUALITY CONTROL:

A. Perform tests and inspections.
   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
      a. Test and demonstrate safety showers and eyewashes for Owner.
   3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Electric, tempered water skids will be considered defective if they do not pass tests and inspections. Contractor responsible for vendor coordination, as necessary, to correct the work. Contractor to provide schedule on retesting and reinspection to Owner and Design Professional

C. Prepare test and inspection reports.

END OF SECTION

Stormwater Pollution Prevention Plan

for:

UNIVERSITY OF MISSOURI – COLUMBIA
RESEARCH COMMONS THERMAL PLANT CHILLED WATER PRODUCTION ADDITION
1404 CARRIE FRANCKE DRIVE, COLUMBIA, BOONE COUNTY, MISSOURI 65203

PROJECT # CP232801

LAND DISTURBANCE PERMIT # MOR100039

Operator(s):

UNIVERSITY OF MISSOURI - COLUMBIA
Columbia, MO 65211

SWPPP Contact(s):

Powell CWM, Inc.

3200 S. State Route 291, Building 1

Independence, MO 64057

816-373-4800

SWPPP Preparation Date:

2025-01-21

Estimated Project Dates:

Project Start Date: **03 / 03 / 2025**
Project Completion Date: **08 / 11 / 2026**

Contents

SECTION 1: SITE EVALUATION, ASSESSMENT, AND PLANNING

1.1 Project/Site Information

Instructions:

- In this section, you can gather some basic site information that will be helpful to you later when you file for permit coverage.
- For more information, see *Developing Your Stormwater Pollution Prevention Plan: A SWPPP Guide for Construction Sites* (also known as the *SWPPP Guide*), Chapter 2
- Detailed information on determining your site's latitude and longitude can be found at www.epa.gov/npdes/stormwater/latlong

Project/Site Name: **UNIVERSITY OF MISSOURI – COLUMBIA -RESEARCH COMMONS THERMAL PLANT CHILLED WATER PRODUCTION ADDITION**

Project Street/Location: 1404 CARRIE FRANCKE DRIVE
City: COLUMBIA State: MO ZIP Code: 65203
County or Similar Subdivision: BOONE COUNTY

Latitude/Longitude (Use one of three possible formats, and specify method)

Latitude:	Longitude:
1. _ º _ _ ' _ _" N (degrees, minutes, seconds)	1. _ _ º _ _ ' _ _" W (degrees, minutes, seconds)
2. _ _ º _ _ . _ _' N (degrees, minutes, decimal)	2. _ _ º _ _ . _ _' W (degrees, minutes, decimal)
3. 38. 93427 º N (decimal)	3. 92. 34019 º W (decimal)

Method for determining latitude/longitude:
☐ USGS topographic map (specify scale: _____) ☐ EPA Web site ☐ GPS
☒ Other (please specify): Google Earth

Is the project located in Indian country? ☐ Yes ☒ No
If yes, name of Reservation, or if not part of a Reservation, indicate "not applicable."_____

Is this project considered a federal facility? ☐ Yes ☒ No

NPDES project or permit tracking number*: **Land Disturbance Permit MOR100039**
**(This is the unique identifying number assigned to your project by your permitting authority after you have applied for coverage under the appropriate National Pollutant Discharge Elimination System (NPDES) construction general permit.)*

1.2 Contact Information/ Responsable Parties

Instructions:

- List the operator(s), project managers, stormwater contact(s), and person or organization that prepared the SWPPP. Indicate respective responsibilities, where appropriate.
- Also, list subcontractors expected to work on-site. Notify subcontractors of stormwater requirements applicable to their work.
- See *SWPPP Guide*, Chapter 2.B.

Operator(s):

UNIVERSITY OF MISSOURI - COLUMBIA
Columbia, MO 65211

Project Manager(s) or Site Supervisor(s):

MU Construction Site Inspector
Philip Thunhorst
Inspector/Plan Reviewer
MU Planning, Design and Construction
(573) 882-9043

SWPPP Contact(s):
MU Contacts for Environmental Concerns:
Ted Haeussler
Environmental Compliance Specialist MU environmental Health & Safety
haeusslert@missouri.edu
(573) 882-3950
Alec Brown
Environmental Compliance Specialist MU environmental Health & Safety
anbf2f@missouri.edu
(573) 884-6814

POWELL CWM, Inc.
Jadrienne Rodell -Tipton
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816-373-4800

This SWPPP was Prepared by:

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3200 S. State Route 291, Building 1
Independence, MO 64057
816-373-4800
jrodell-tipton@powellcwm.com

Subcontractor(s):

Insert Company or Organization Name:
Insert Name:
Insert Address:
Insert City, State, Zip Code:
Insert Telephone Number:
Insert Fax/Email:

Emergency 24-Hour Contact:

Insert Company or Organization Name:
Insert Name:
Insert Telephone Number:

1.3 Nature and Sequence of Construction Activity

Instructions:

- Briefly describe the nature of the construction activity and approximate time frames (one or more paragraphs, depending on the nature and complexity of the project).
- For more information, see *SWPPP Guide*, Chapter 3.A.

Describe the general scope of the work for the project, major phases of construction, etc:

The proposed project is an addition of the new Research Commons Thermal Plant Chilled Water Production at 1400 Carrie Francke Dr. The new structure will approximately be 90 by 70 feet in plan, sidewalk, driveways, and underground utilities.

What is the function of the construction activity?

Chilled Water Production Addition

☐ Residential ☐ Commercial ☒ Industrial ☐ Road Construction ☐ Linear Utility

☐ Other (please specify):

Estimated Project Start Date: **03 / 03 / 2025**

Estimated Project Completion Date: **08 / 11 / 2026**

Estimated Timeline of activity	Construction activity and BMP s description
03/2025 - 04/2025	**Before any site grading activities begin** 1. Install perimeter silt fences. 2. Install storm drain inlet protection on Carrie Francke Drive. 3. Construct stabilized construction exits. 4. Construct vegetated swale along the north perimeter. 5. Construct sediment trap.
05/2025 - 07/2025	**Site grading** 1. Begin site clearing and grubbing operations. 2. Begin overall site grading and top-soil stripping. 3. Disturbed areas where construction will cease for more than 4. days will be stabilized with erosion controls.
08/2025 - 10/2025	**Infrastructure (utilities, parking lot, etc.)** 1. Construct staging and materials storage area. 2. Install temporary sanitary facilities and dumpsters 3. Install utilities, sanitary sewers, and water services
10/2025 - 06/2026	**Building Construction** 1. Begin construction of the building foundation and structure. 2. Install gutters, curbs, and prepare pavement subgrade. 3. Implement winter stabilization procedures

06/2026 - 08/2026	**Final stabilization and landscaping** 1. Finalize pavement activities. 2. Remove all temporary control BMPs and stabilize any areas disturbed by their removal with erosion controls 3. Prepare final seeding and landscaping. 4. Monitor stabilized areas until final stabilization is reached.

1.4 Soils, Slopes, Vegetation, and Current Drainage Patterns

Instructions:

- Describe the existing soil conditions at the construction site including soil types, slopes and slope lengths, drainage patterns, and other topographic features that might affect erosion and sediment control.
- Also, note any historic site contamination evident from existing site features and known past usage of the site.
- This information should also be included on your site maps (See *SWPPP Guide*, Chapter 3.C.).
- For more information, see *SWPPP Guide*, Chapter 3.A.

Soil Type:

See attached Soil Report.

Slopes (describe current slopes and note any changes due to grading or fill activities):

The north side of the site slopes down to Carrie Franke Drive.

Drainage Patterns (describe current drainage patterns and note any changes due to grading or fill activities):

Currently, part of the site drains to a double area inlet to the west, while the other part of the site drains to a swale leading to a field inlet to the east.

Vegetation:

Mixture of weeds and woodlands. Trees throughout the property.

1.5 Construction Site Estimates

Instructions:

- Estimate the area to be disturbed by excavation, grading, or other construction activities, including dedicated off-site borrow and fill areas.
- Calculate the percentage of impervious surface area before and after construction
- Calculate the runoff coefficients before and after construction.
- For more information, see *SWPPP Guide*, Chapter 3.A and Appendix C.

The following are estimates of the construction site.

Total project area:	NA
Construction site area to be disturbed:	1.29 acres
Percentage impervious area before construction:	15.34 %
Runoff curve number (CN) before construction:	84
Percentage impervious area after construction:	32.01%
Runoff curve number (CN) after construction	86

1.6 Receiving Waters

Instructions:

- List the waterbody(s) that would receive stormwater from your site, including streams, rivers, lakes, coastal waters, and wetlands. Describe each as clearly as possible, such as *Mill Creek, a tributary to the Potomac River*, and so on.
- Indicate the location of all waters, including wetlands, on the site map.
- Note any stream crossings, if applicable.
- List the storm sewer system or drainage system that stormwater from your site could discharge to and the waterbody(s) that it ultimately discharges to.
- If any of the waterbodies above are impaired and/or subject to Total Maximum Daily Loads (TMDLs), please list the pollutants causing the impairment and any specific requirements in the TMDL(s) that are applicable to construction sites. Your SWPPP should specifically include measures to prevent the discharge of these pollutants.
- For more information, see *SWPPP Guide*, Chapter 3.A and 3.B.
- Also, for more information and a list of TMDL contacts and links by state, visit www.epa.gov/npdes/stormwater/tmdl.

Description of receiving waters:
The Runoff from the site is a part of the Hinkson Creek Watershed.
No jurisdictional waters are impacted by this project.

Description of storm sewer systems:
Currently, part of the site drains to a double area inlet to the west, while the other part of the site drains to a swale leading to a field inlet to the east.
Upon development, the storm water will collect runoff and drain into the double area inlet and the existing rain garden, while the North- East side of the site runoff will collect and drain into the existing street inlet and raingarden offsite.

Description of impaired waters or waters subject to TMDLs: N/A

Other:
Trees along the northern property line of the site are to be preserved

Description of unique features that are to be preserved: N/A.

Describe measures to protect these features: N/A

1.7 Site Features and Sensitive Areas to be Protected

Instructions:

- Describe unique site features including streams, stream buffers, wetlands, specimen trees, natural vegetation, steep slopes, or highly erodible soils that are to be preserved.
- Describe measures to protect these features.
- Include these features and areas on your site maps.
- For more information, see *SWPPP Guide*, Chapter 3.A and 3.B.

Description of unique features that are to be preserved:

Existing rain garden to be protected during construction and restored to design operating conditions with final site clean-up.

Describe measures to protect these features:

1. Install perimeter silt fences.

1.8 Potential Sources of Pollution

Instructions:

- Identify and list all potential sources of sediment, which may reasonably be expected to affect the quality of stormwater discharges from the construction site.
- Identify and list all potential sources of pollution, other than sediment, which may reasonably be expected to affect the quality of stormwater discharges from the construction site.
- For more information, see *SWPPP Guide*, Chapter 3.A.

Potential sources of sediment to stormwater runoff:

- Clearing and grubbing operations
- Grading and site excavation operations
- Vehicle tracking
- Topsoil stripping
- Landscaping operations

Potential pollutants and sources, other than sediment, to stormwater runoff:

- Combined Staging Area—small fueling activities, minor equipment maintenance, sanitary facilities, and hazardous waste storage.
- Materials Storage Area—general building materials, solvents, adhesives, paving materials, paints, aggregates, trash, and so on.
- Construction Activity—paving, curb/gutter installation, concrete pouring/mortar/stucco, and building construction
- Concrete Washout Area

For all potential construction site pollutants, see Table below.

Material/Chemical	Physical description	Stormwater Pollutants	Location
Pesticides (insecticides, fungicides, herbicides, rodenticides)	Various colored to colorless liquid, powder, pellets, or grains	Chlorinated hydrocarbons, organophosphates, carbamates, arsenic	Herbicides used for noxious weed control
Fertilizer	Liquid or solid grains	Nitrogen, phosphorous	Newly seeded areas
Plaster	White granules or powder	Calcium sulphate, calcium carbonate, sulfuric acid	Building construction
Cleaning solvents	Colorless, blue, or yellow-green liquid	Perchloroethylene, methylene chloride, trichloroethylene, petroleum distillates	No equipment cleaning allowed in project limits
Asphalt	Black solid	Oil, petroleum distillates	Streets and roofing
Concrete	White solid/grey liquid	Limestone, sand, pH, chromium	Curb and gutter, building construction
Glue, adhesives	White or yellow liquid	Polymers, epoxies	Building construction
Paints	Various colored liquid	Metal oxides, stoddard solvent, talc, calcium carbonate, arsenic	Building construction
Curing compounds	Creamy white liquid	Naphtha	Curb and gutter
Wood preservatives	Clear amber or dark brown liquid	Stoddard solvent, petroleum distillates, arsenic, copper, chromium	Timber pads and building construction
Hydraulic oil/fluids	Brown oily petroleum hydrocarbon	Mineral oil	Leaks or broken hoses from equipment
Gasoline	Colorless, pale brown or pink petroleum hydrocarbon	Benzene, ethyl benzene, toluene, xylene, MTBE	Secondary containment/staging area
Diesel Fuel	Clear, blue green to yellow liquid	Petroleum distillate, oil & grease, naphthalene, xylenes	Secondary containment/staging area
Kerosene	Pale yellow liquid petroleum hydrocarbon	Coal oil, petroleum distillates	Secondary containment/staging area
Antifreeze/coolant	Clear green/yellow liquid	Ethylene glycol, propylene glycol, heavy metals (copper, lead, zinc)	Leaks or broken hoses from equipment
Sanitary toilets	Various colored liquid	Bacteria, parasites, and viruses	Staging area

1.9 Endangered Species Certification

Instructions:

- Before beginning construction, determine whether endangered or threatened species or their critical habitats are on or near your site.
- Adapt this section as needed for state or tribal endangered species requirements and, if applicable, document any measures deemed necessary to protect endangered or threatened species or their critical habitats.
- For more information on this topic, see *SWPPP Guide*, Chapter 3.B.
- Additional information on Endangered Species Act (ESA) provisions is at www.epa.gov/npdes/stormwater/esa

Are endangered or threatened species and critical habitats on or near the project area?

☐ Yes ☒ No

Describe how this determination was made:

NMFS EA ESA Critical Habitat Mapper.

If yes, describe the species and/or critical habitat:

N/A

If yes, describe or refer to documentation that determines the likelihood of an impact on identified species and/or habitat and the steps taken to address that impact. (Note, if species are on or near your project site, EPA strongly recommends that the site operator work closely with the appropriate field office of the U.S. Fish and Wildlife Service or National Marine Fisheries Service. For concerns related to state or tribal listing of species, please contact a state or tribal official.)

N/A

1.10 Historic Preservation

Instructions:

- Before you begin construction, you should review federal and any applicable state, local, or tribal historic preservation laws and determine if there are historic sites on or near your project. If so, you might need to make adjustments to your construction plans or to your stormwater controls to ensure that these historic sites are not damaged.
- For more information, see *SWPPP Guide*, Chapter 3.B or contact your state or tribal historic preservation officer.

Are there any historic sites on or near the construction site?

☐ Yes ☒ No

Describe how this determination was made:

National Register of Historic Places.

If yes, describe or refer to documentation that determines the likelihood of an impact on this historic site and the steps taken to address that impact.

N/A

1.11 Applicable Federal, Tribal, State or Local Programs

Instructions:

- Note other applicable federal, tribal, state or local soil and erosion control and stormwater management requirements that apply to your construction site.

404 Permit not required for project work.

1.12 Maps

Instructions:

- Attach site maps. For most projects, a series of site maps is recommended. The first should show the undeveloped site and its current features. An additional map or maps should be created to show the developed site or for more complicated sites show the major phases of development.

These maps should include the following:

- Direction(s) of stormwater flow and approximate slopes before and after major grading activities;
- Areas and timing of soil disturbance;
- Areas that will not be disturbed;
- Natural features to be preserved;
- Locations of major structural and non-structural BMPs identified in the SWPPP;
- Locations and timing of stabilization measures;
- Locations of off-site material, waste, borrow, or equipment storage areas.
- Locations of all waters of the United States, including wetlands;
- Locations where stormwater discharges to a surface water;
- Locations of storm drain inlets; and
- Areas where final stabilization has been accomplished.
- For more information, see *SWPPP Guide*, Chapter 3.C.

See Appendix B – Site Maps.

SECTION 2: EROSION AND SEDIMENT CONTROL BMPS

Instructions:

- Describe the BMPs that will be implemented to control pollutants in stormwater discharges. For each major activity identified, do the following
  - ✓ Clearly describe appropriate control measures.
  - ✓ Describe the general sequence during the construction process in which the measures will be implemented.
  - ✓ Describe the maintenance and inspection procedures that will be used for that specific BMP.
  - ✓ Include protocols, thresholds, and schedules for cleaning, repairing, or replacing damaged or failing BMPs.
  - ✓ Identify staff responsible for maintaining BMPs.
  - ✓ (If your SWPPP is shared by multiple operators, indicate the operator responsible for each BMP.)
- Categorize each BMP under one of the following 10 areas of BMP activity as described below:
  - ***2.1 Minimize disturbed area and protect natural features and soil***
  - ***2.2 Phase Construction Activity***
  - ***2.3 Control Stormwater flowing onto and through the project***
  - ***2.4 Stabilize Soils***
  - ***2.5 Protect Slopes***
  - ***2.6 Protect Storm Drain Inlets***
  - ***2.7 Establish Perimeter Controls and Sediment Barriers***
  - ***2.8 Retain Sediment On-Site and Control Dewatering Practices***
  - ***2.9 Establish Stabilized Construction Exits***
  - ***2.10 Any Additional BMPs***
- Note the location of each BMP on your site map(s).
- For any structural BMPs, you should provide design specifications and details and refer to them. Attach them as appendices to the SWPPP or within the text of the SWPPP.
- For more information, see *SWPPP Guide*, Chapter 4.
- Consult your state's design manual or one of those listed in Appendix D of the *SWPPP Guide*.
- For more information or ideas on BMPs, see EPA's National Menu of BMPs http://www.epa.gov/npdes/stormwater/menuofbmps

2.1 Minimize Disturbed Area and Protect Natural Features and Soil

Instructions:

- Describe the areas that will be disturbed with each phase of construction and the methods (e.g., signs, fences) that you will use to protect those areas that should not be disturbed. Describe natural features identified earlier and how each will be protected during construction activity. Also describe how topsoil will be preserved. Include these areas and associated BMPs on your site map(s) also. (For more information, see *SWPPP Guide*, Chapter 4, ESC Principle 1.)
- Also, see EPA's *Preserving Natural Vegetation BMP Fact Sheet* at www.epa.gov/npdes/stormwater/menuofbmps/construction/perserve_veg

Topsoil

BMP Description: a silt fence will be installed around the perimeter during grading activities	
Installation Schedule:	Temporary stabilization will be applied immediately after the slopes have been graded.
Maintenance and Inspection:	The area will be inspected weekly for erosion and immediately after storm events.
Responsible Staff:	Contractor

2.2 Phase Construction Activity

Instructions:

- Describe the intended construction sequencing and timing of major activities, including any opportunities for phasing grading and stabilization activities to minimize the overall amount of disturbed soil that will be subject to potential erosion at one time. Also, describe opportunities for timing grading and stabilization so that all or a majority of the soil disturbance occurs during a time of year with less erosion potential (i.e., during the dry or less windy season). (For more information, see *SWPPP Guide*, Chapter 4, ESC Principle 2.) It might be useful to develop a separate, detailed site map for each phase of construction.
- Also, see EPA's *Construction Sequencing BMP Fact Sheet* at http://www.epa.gov/npdes/stormwater/menuofbmps/construction/cons_seq)

- Phase I
  - Initial ESC measures installed before construction or any site disturbance
  - Temporary construction entrance
  - Perimeter silt fence
  - Inlet Protection

- Phase II
  - Building Construction
  - Duration of phase (start date, end date): Per Contractor
  - Construction Entrance, Silt Fence, Concrete Washout and Inlet Protection
  - No stabilization needed for this phase

- Phase III
  - Paving/Landscape
  - Duration of phase (start date, end date): Per Contractor
  - Temporary Control measures shall be removed
  - Permanent Surface Stabilization (Permanent Seeding, Mulching, Sodding)

2.3 Control Stormwater Flowing onto and through the Project

Instructions:

- Describe structural practices (e.g., diversions, berms, ditches, storage basins) including design specifications and details used to divert flows from exposed soils, retain or detain flows, or otherwise limit runoff and the discharge of pollutants from exposed areas of the site. (For more information, see *SWPPP Guide*, Chapter 4, ESC Principle 3.)

Vegetate swale

BMP Description: A vegetated swale will be installed along the northern perimeter of the site to capture stormwater run-on from the adjacent property. The swale will convey stormwater to a raised storm drain inlet in the North-Est corner of the site. The inlet will be raised 1 foot above the bottom of the swale to allow for infiltration of the run-on. The vegetated swale will have a trapezoidal shape with a slope ratio of 2:1. The bottom of the swale will be at least 2 feet above the seasonal high-water table and bedrock. The slopes of the swale will be stabilized with a dense cover of water-tolerant, erosion-resistant grasses, mulch and erosion control blankets immediately after final grade is reached. The vegetated swale will remain as a permanent stormwater structure after construction is complete. For design specifications.

Installation Schedule:	The vegetated swale will be installed before site grading operations begin at the construction site.
Maintenance and Inspection:	The swale will be inspected for erosion and structural failures weekly and immediately after storm events. Before vegetation has been established in the swale, it will be inspected for erosion and accumulation of debris and sediment. Remove debris, sediment, and repair erosion and embankments immediately.
Responsible Staff:	Contractor

2.4 Stabilize Soils

Instructions:

- Describe controls (e.g., interim seeding with native vegetation, hydroseeding) to stabilize exposed soils where construction activities have temporarily or permanently ceased. Also describe measures to control dust generation. Avoid using impervious surfaces for stabilization whenever possible. (For more information, see *SWPPP Guide*, Chapter 4, ESC Principle 4.)
- Also, see EPA's *Seeding BMP Fact Sheet* at www.epa.gov/npdes/stormwater/menuofbmps/construction/seeding

Temporary Stabilization

BMP Description: Hydro mulching will provide immediate protection to exposed soils where construction will cease for more than 14 days and over the winter months. Straw mulch and wood fiber will be mixed with a tackifier (amount specified per manufacturer's instructions) and applied uniformly by machine with an application rate of 90–100 pounds (2–3 bales) per 1,000 square feet or 2 tons (100–200 bales) per acre. If the tackifier does not appear effective in anchoring the mulch to the disturbed soil, crimping equipment will be used to provide additional binding to the soil. The mulch will cover 75 to 90 percent of the ground surface. In areas where hydro mulching is inaccessible, straw mulch will be applied by hand with an application rate of 90–100 pounds (2–3 bales) per 1,000 square feet.

Winter stabilization will occur between November 15 and March 15. All disturbed areas are scheduled to be stabilized well before winter; however, if any vegetated areas show signs of erosion, mulch will be applied at the same rate as described above.

☐ ***Permanent***	☒ ***Temporary***
Installation Schedule:	Portions of the site where construction activities will temporarily cease for more than 14 days will be stabilized with mulch. Winter stabilization will occur between November 15th and March 15
Maintenance and Inspection:	Mulched areas will be inspected weekly and after storm events to check for movement of mulch or erosion. If washout, breakage, or erosion occurs, the surface will be repaired, and new mulch will be applied to the damaged area.
Responsible Staff:	Contractor

Permanent Stabilization

BMP Description: Permanent stabilization will be done immediately after the final design grades are achieved but no later than 14 days after construction ceases. Native species of plants will be used to establish vegetative cover on exposed soils. Permanent stabilization will be completed in accordance with the final stabilization procedures in Section 7**.**

☒ ***Permanent***	☐ ***Temporary***
Installation Schedule:	Portions of the site where construction activities have permanently ceased will be stabilized, as soon as possible but no

	later than 14 days after construction ceases.
Maintenance and Inspection:	All seeded areas will be inspected weekly during construction activities for failure and after storm events until a dense cover of vegetation has been established. If failure is noticed at the seeded area, the area will be reseeded, fertilized, and mulched immediately. After construction is completed at the site, permanently stabilized areas will be monitored until final stabilization is reached.
Responsible Staff:	Contractor

Dust Control

BMP Description: Dust from the site will be controlled by using a mobile pressure-type distributor truck to apply potable water to disturbed areas. The mobile unit will apply water at a rate of 300 gallons per acre and minimized as necessary to prevent runoff and ponding.	
Installation Schedule:	Dust control will be implemented as needed once site grading has been initiated and during windy conditions (forecasted or actual wind conditions of 20 mph or greater) while site grading is occurring. Spraying of potable water will be performed no more than three times a day during the months of May–September and once per day during the months of October–April or whenever the dryness of the soil warrants it.
Maintenance and Inspection:	At least one mobile unit will be available at all times to distribute potable water to control dust on the project area. Each mobile unit will be equipped with a positive shutoff valve to prevent overwatering of the disturbed area. For vehicle and equipment maintenance practices, see Section 3, Part 3.4.
Responsible Staff:	Contractor

2.5 Protect Slopes

Instructions:

- Describe controls (e.g., erosion control blankets, tackifiers) including design specifications and details that will be implemented to protect all slopes. (For more information, see *SWPPP Guide*, Chapter 4, ESC Principle 5.)
- Also, see EPA's *Geotextiles BMP Fact Sheet* at www.epa.gov/npdes/stormwater/menuofbmps/construction/geotextiles

BMP Description: Geotextile erosion control blankets will be used to provide stabilization for the slopes in the vegetated swale and sediment trap. The blanket will cover the entire area of the graded slope and bottom channel. The bottom and side slopes will be seeded and mulched before the blanket is applied. The blanket will be installed by digging a small trench on the upside of the slope, 12 inches wide by 6 inches deep, and stapling the leading edge of the blanket in the trench. The blanket will be rolled down the slope slowly to maintain soil contact and stapled in 12-inch intervals. If the blanket cannot cover the entire slope, the blankets will be overlapped (minimum of 2 inches) and stapled at the overlapped edge. The erosion control blanket will always be installed according to the manufacturer's instructions and specifications. For design specifications.

Installation Schedule:	The erosion control blankets will be installed once the vegetated swale and sediment trap have reached final grade.
Maintenance and Inspection:	The erosion control blanket will be inspected weekly and immediately after storm events to determine if cracks, tears, or breaches have formed in the fabric; if so, the blanket will be repaired or replaced immediately. Good contact with the soil must be maintained and erosion should not occur under the blanket. Any areas where the blanket is not in close contact with the ground will be repaired or replaced.
Responsible Staff:	Contractor

2.6 Protect Storm Drain Inlets

Instructions:

- Describe controls (e.g., inserts, rock-filled bags, or block and gravel) including design specifications and details that will be implemented to protect all inlets receiving stormwater from the project during the entire project. (For more information, see *SWPPP Guide*, Chapter 4, ESC Principle 6.)
- Also, see EPA's *Storm Drain Inlet Protection BMP Fact Sheet* at www.epa.gov/npdes/stormwater/menuofbmps/construction/storm_drain

Existing Storm Drain Inlet in the Vegetated Swale

BMP Description: : Filtrexx Soxx (compost filter sock)will be installed around the perimeter of the storm drain inlet. The rolls will consist of rolled tubes of erosion control blankets (8 inches in diameter) and bound at each end with jute-type twine. The rolls will be installed in shallow trenches dug 2–4 inches below ground surface and staked into the ground using wooden stake (24 inches long) 3 to 4 feet apart.

Installation Schedule:	Filtrexx Soxx and check dams will be installed once the swale has erosion control blankets in place and has been stabilized.
Maintenance and Inspection:	Filtrexx Soxx will be inspected weekly and immediately after storm events to replace or repair split, torn, unraveled or slumping rolls. Accumulated sediment will be removed when accumulation reaches one-third the height of the fiber roll. The removed sediment will be hauled off-site and disposed of at the nearest Landfill.
Responsible Staff:	Contractor

Storm Drain Inlet protection before paving

BMP Description: A silt fence barrier will be constructed around all storm drain inlets except the storm drain inlet in the vegetated swale. The silt fence barrier will be installed by excavating a 12-inch-deep trench around the storm drain inlet. Wooden posts supporting the silt fence will be spaced 2 to 3 feet apart and driven securely into the ground; a minimum of 18 to 20 inches deep. The bottom edge of the silt fence will extend across the bottom of the trench and the trench will be backfilled and compacted to prevent stormwater and sediment from discharging underneath the silt fence.

Installation Schedule:	Once the storm drains inlets have been installed on-site, silt fences will be immediately placed around the inlets. The sediment fences surrounding the six storm drain inlets on the main road will be removed and replaced with gravel bag barriers once the pavement subgrade has been applied.
Maintenance and Inspection:	For maintenance and inspection procedures for the silt fence, see Section 2, Part 2.7.
Responsible Staff:	Contractor

Storm Drain Inlet protection after paving

BMP Description: Inlet Filter will be installed around the perimeter of the storm drain inlet.	
Installation Schedule:	Once the storm drains inlets have been installed on-site, inlet filter will be immediately placed around the inlets.
Maintenance and Inspection:	For maintenance and inspection procedures for the silt fence.
Responsible Staff:	Contractor

2.7 Establish Perimeter Controls and Sediment Barriers

Instructions:

- Describe structural practices (e.g., silt fences or fiber rolls) including design specifications and details to filter and trap sediment before it leaves the construction site. (For more information, see *SWPPP Guide*, Chapter 4, ESC Principle 7.)
- Also see, EPA's *Silt Fence BMP Fact Sheet* at www.epa.gov/npdes/stormwater/menuofbmps/construction/silt_fences, or *Fiber Rolls BMP Fact Sheet* at www.epa.gov/npdes/stormwater/menuofbmps/construction/fiber_rolls

BMP Description: Silt fences will be installed along the perimeter of the site. Silt fences will be installed by excavating a 12-inch-deep trench along the line of proposed installation. Wooden posts supporting the silt fence will be spaced 4 to 6 feet apart and driven securely into the ground; a minimum of 18 to 20 inches deep. The silt fence will be fastened securely to the wooden posts with wire ties spaced every 24 inches at the top, mid-section, and bottom of the wooden post. The bottom edge of the silt fence will extend across the bottom of the trench and the trench will be backfilled and compacted to prevent stormwater and sediment from discharging underneath the silt fence.

Installation Schedule:	The silt fences will be installed before construction begins at the site.
Maintenance and Inspection:	Silt fences will be inspected weekly and immediately after storm events to ensure it is intact and that there are no gaps where the fence meets the ground or tears along the length of the fence. If gaps or tears are found during the inspection, the fabric will be repaired or replaced immediately. Accumulated sediment will be removed from the fence base if it reaches one-third the height of the silt fence and hauled off-site for disposal at nearest Landfill. If accumulated sediment is creating noticeable strain on the fabric and the fence might fail from a sudden storm event, the sediment will be removed more frequently. Before the fence is removed from the project area, the sediment will be removed. The anticipated life span of the silt fence is 6 months and will likely need to be replaced after this period.
Responsible Staff:	Contractor

2.8 Retain Sediment On-Site

Instructions:

- Describe sediment control practices (e.g., sediment trap or sediment basin), including design specifications and details (volume, dimensions, outlet structure) that will be implemented at the construction site to retain sediments on-site. (For more information, see *SWPPP Guide*, Chapter 4, ESC Principle 8.)
- Also, see EPA's *Sediment Basin BMP Fact Sheet* at www.epa.gov/npdes/stormwater/menuofbmps/construction/sediment_basins

BMP Description:	
Installation Schedule:	N/A
Maintenance and Inspection:	N/A
Responsible Staff:	

Not appropriate for this site due to available space and size of disturbed area.
Sediment barriers listed previously are the primary methods of sediment retention.

2.9 Establish Stabilized Construction Exits

Instructions:

- Describe location(s) of vehicle entrance(s) and exit(s), procedures to remove accumulated sediment off-site (e.g., vehicle tracking), and stabilization practices (e.g., stone pads or wash racks or both) to minimize off-site vehicle tracking of sediments and discharges to stormwater. (For more information, see *SWPPP Guide*, Chapter 4, ESC Principle 9.)
- Also, see EPA's *Construction Entrances BMP Fact Shee*t at www.epa.gov/npdes/stormwater/menuofbmps/construction/cons_entrance

BMP Description: Tracking mat/rock entrance	
Installation Schedule:	Install track-out controls anywhere construction traffic leaves or enters a construction site
Maintenance and Inspection:	Inspect at the end of each workday.
Responsible Staff:	Contractor

2.10 Additional BMPs

Instructions:

- Describe additional BMPs that do not fit into the above categories.

BMP Description:	
Installation Schedule:	
Maintenance and Inspection:	
Responsible Staff:	

SECTION 3: GOOD HOUSEKEEPING BMPS

Instructions:

- Describe the key good housekeeping and pollution prevention (P2) BMPs that will be implemented to control pollutants in stormwater.
- Categorize each good housekeeping and pollution prevention (P2) BMP under one of the following seven categories:
  - ***3.1 Material Handling and Waste Management***
  - ***3.2 Establish Proper Building Material Staging Areas***
  - ***3.3 Designate Washout Areas***
  - ***3.4 Establish Proper Equipment/Vehicle Fueling and Maintenance Practices***
  - ***3.5 Allowable Non-Stormwater Discharges and Control Equipment/Vehicle Washing***
  - ***3.6 Spill Prevention and Control Plan***
  - ***3.7 Any Additional BMPs***
- For more information, see *SWPPP Guide*, Chapter 5.
- Consult your state's design manual or resources in Appendix D of the *SWPPP Guide*.
- For more information or ideas on BMPs, see EPA's National Menu of BMPs http://www.epa.gov/npdes/stormwater/menuofbmps

- Following good housekeeping practices at project site, such as appropriately disposing of unwanted or unused waste material and immediately cleaning up spills or debris.

- Storing materials off the bare ground and away from vehicular traffic and drainage pathways.

3.1 Material Handling and Waste Management

Instructions:

- Describe measures (e.g., trash disposal, sanitary wastes, recycling, and proper material handling) to prevent the discharge of solid materials to receiving waters, except as authorized by a permit issued under section 404 of the CWA (For more information, see *SWPPP Guide*, Chapter 5, P2 Principle 1.)
- Also, see EPA's *General Construction Site Waste Management BMP Fact Sheet* at www.epa.gov/npdes/stormwater/menuofbmps/construction/cons_wasteman

Waste Materials

BMP Description: All waste materials will be collected and disposed of into metal trash dumpsters in the materials storage area. Dumpsters will have a secure watertight lid, be placed away from stormwater conveyances and drains, and meet all federal, state, and municipal regulations. Only trash and construction debris from the site will be deposited in the dumpster. No construction materials will be buried on-site. All personnel will be instructed, during tailgate training sessions, regarding the correct disposal of trash and construction debris. Notices that state these practices will be posted in the office trailer and the individual who manages day-today site operations will be responsible for seeing that these practices are followed.

Installation Schedule:	Trash dumpsters will be installed once the materials storage area has been established.
Maintenance and Inspection:	The dumpsters will be inspected weekly and immediately after storm events. The dumpster will be emptied weekly. If trash and construction debris are exceeding the dumpster's capacity, the dumpsters will be emptied more frequently.
Responsible Staff:	Contractor

Hazardous Waste Materials

BMP Description: All hazardous waste materials such as oil filters, petroleum products, paint, and equipment maintenance fluids will be stored in structurally sound and sealed shipping containers, within the hazardous materials storage area. Hazardous waste materials will be stored in appropriate and clearly marked containers and segregated from other non-waste materials. Secondary containment will be provided for all waste materials in the hazardous materials storage area and will consist of commercially available spill pallets. Additionally, all hazardous waste materials will be disposed of in accordance with federal, state, and municipal regulations. Hazardous waste materials will not be disposed of into the on-site dumpsters.

All personnel will be instructed, during tailgate training sessions, regarding proper procedures for hazardous waste disposal. Notices that state these procedures will be posted in the office trailer and the individual who manages day-to-day site operations will be responsible for seeing that these procedures are followed.

Only MU Environmental Health & Safety can ship or remove hazardous materials and/or hazardous waste from MU property. Under no circumstances is the contractor to ship or remove hazardous materials or waste from the site. Contact MU EHS at (573)- 882-3736 for assistance.

Installation Schedule:	Shipping containers used to store hazardous waste materials will be installed once the site materials storage area has been installed
Maintenance and Inspection:	The hazardous waste material storage areas will be inspected weekly and after storm events. The storage areas will be kept clean, well-organized, and equipped with ample cleanup supplies as appropriate for the materials being stored. Material safety data sheets, material inventory, and emergency contact numbers will be maintained in the office trailer.
Responsible Staff:	Contractor

Sanitary waste

BMP Description: Temporary sanitary facilities (portable toilets) will be provided at the site throughout the construction phase. The toilets will be in the staging area. The portable toilets will be located away from a concentrated flow paths and traffic flow and will have collection pans underneath as secondary containment.

Installation Schedule:	The portable toilets will be brought to the site once the staging area has been established.
Maintenance and Inspection:	All sanitary waste will be collected from the portable facilities a minimum of three times per week by Ways Waste and Sanitary Services. The portable toilets will be inspected weekly for evidence of leaking holding tanks. Toilets with leaking holding tanks will be removed from the site and replaced with new portable toilets
Responsible Staff:	Contractor

Recycling

BMP Description: Wood pallets, cardboard boxes, and other recyclable construction scraps will be disposed of in a designated dumpster for recycling. The dumpster will have a secure watertight lid, be placed away from stormwater conveyances and drains and meet all local and state solid-waste management regulations. Only solid recyclable construction scraps from the site will be deposited in the dumpster. All personnel will be instructed, during tailgate training sessions, regarding the correct procedure for disposal of recyclable construction scraps. Notices that state these procedures will be posted in the office trailer, and the individual who manages day-to-day site operations will be responsible for seeing that these procedures are followed.

Installation Schedule:	Designated recycling dumpsters will be installed once the combined staging area has been established.
Maintenance and Inspection:	The recycling dumpster will be inspected weekly and immediately after storm events. The recycling dumpster will be emptied weekly and taken to an approved recycling center by Ways Waste and Sanitary Services. If recyclable construction wastes are exceeding the dumpster's capacity, the dumpsters will be emptied more frequently.

Responsible Staff:	Contractor

3.2 Establish Proper Building Material Staging Areas

Instructions:

- Describe construction materials expected to be stored on-site and procedures for storage of materials to minimize exposure of the materials to stormwater. (For more information, see *SWPPP Guide*, Chapter 5, P2 Principle 2.)

Material Storage Area

BMP Description: Construction equipment and maintenance materials will be stored at the combined staging area and materials storage areas. Gravel bag berms will be installed around the perimeter to designate the staging and materials storage area. A watertight shipping container will be used to store hand tools, small parts, and other construction materials.

Nonhazardous building materials such as packaging material (wood, plastic, and glass), and construction scrap material (brick, wood, steel metal scraps, and pipe cuttings) will be stored in a separate covered storage facility adjacent to the shipping container. All hazardous-waste materials such oil filters products, paint, and equipment maintenance fluids will be stored in structurally sound and sealed containers under cover within the hazardous materials storage area.

Very large items, such as framing materials and stockpiled lumber, will be stored in the open in materials storage area. Such materials will be elevated on wood blocks to minimize contact with runoff

Installation Schedule:	The materials storage area will be installed after grading and before any infrastructure is constructed at the site.
Maintenance and Inspection:	The storage area will be inspected weekly and after storm events. The storage area will be kept clean, well-organized, and equipped with ample cleanup supplies as appropriate for the materials being stored. Perimeter controls, containment structures, covers, and liners will be repaired or replaced as needed to maintain proper function.
Responsible Staff:	Contractor

3.3 Designate Washout Areas

Instructions:

- Describe location(s) and controls to eliminate the potential for discharges from washout areas for concrete mixers, paint, stucco, and so on. (For more information, see *SWPPP Guide*, Chapter 5, P2 Principle 3.)
- Also, see EPA's *Concrete Washout BMP Fact Sheet* at www.epa.gov/npdes/stormwater/menuofbmps/construction/concrete_wash

BMP Description: Concrete contractors should be encouraged, where possible, to use the washout facilities at their own plants or dispatch facilities.

Washout areas should also be provided for paint and stucco operations. EPA recommends that you locate them at least 50 yards away from storm drains and watercourses whenever possible.

Installation Schedule:	Contractor to determine location of concrete washout area
Maintenance and Inspection:	The construction site superintendent should make ready mixed truck drivers aware of washout facility locations and be watchful for improper dumping of cementitious material. In addition, concrete washout requirements should be included in contracts with concrete delivery companies.
Responsible Staff:	Contractor

3.4 Establish Proper Equipment/Vehicle Fueling and Maintenance Practices

Instructions:

- Describe equipment/vehicle fueling and maintenance practices that will be implemented to control pollutants to stormwater (e.g., secondary containment, drip pans, and spill kits) (For more information, see *SWPPP Guide*, Chapter 5, P2 Principle 4.)
- Also, see EPA's *Vehicle Maintenance and Washing Areas BMP Fact Sheet* at www.epa.gov/npdes/stormwater/menuofbmps/construction/vehicile_maintain

Vehicle/Equipment Fueling and Maintenance

BMP Description: Several types of vehicles and equipment will be used on-site throughout the project, including graders, scrapers, excavators, loaders, paving equipment, rollers, trucks and trailers, backhoes, and forklifts. All major equipment/vehicle fueling and maintenance will be performed off-site. A small, 20-gallon pickup bed fuel tank will be kept on-site in the combined staging area. When vehicle fueling must occur on-site, the fueling activity will occur in the staging area. Only minor equipment maintenance will occur on-site. All equipment fluids generated from maintenance activities will be disposed of into designated drums stored on spill pallets in accordance with Part 3.1. Absorbent, spill-cleanup materials and spill kits will be available at the combined staging and materials storage area. Drip pans will be placed under all equipment receiving maintenance and vehicles and equipment parked overnight**.**

Only MU Environmental Health & Safety can ship or remove hazardous materials and/or hazardous waste from MU property. Under no circumstances is the contractor to ship or remove hazardous materials or waste from the site. Contact MU EHS at (573)- 882-3736 for assistance.

Installation Schedule:	BMPs implemented for equipment and vehicle maintenance and fueling activities will begin at the start of the project.
Maintenance and Inspection:	Inspect equipment/vehicle storage areas and fuel tank weekly and after storm events. Vehicles and equipment will be inspected on each day of use. Leaks will be repaired immediately, or the problem vehicle(s) or equipment will be removed from the project site. Keep ample supply of spill-cleanup materials on-site and immediately clean up spills and dispose of materials properly.
Responsible Staff:	Contractor

3.5 Control Equipment/Vehicle Washing

Instructions:

- Describe equipment/vehicle washing practices that will be implemented to control pollutants to stormwater. (For more information, see *SWPPP Guide*, Chapter 5, P2 Principle 5.)
- Also, see EPA's *Vehicle Maintenance and Washing Areas BMP Fact Sheet* at www.epa.gov/npdes/stormwater/menuofbmps/construction/vehicile_maintain

BMP Description: N/A	
Installation Schedule:	N/A
Maintenance and Inspection:	N/A
Responsible Staff:	Contractor

3.6 Spill Prevention and Control Plan

Instructions:

- Describe the spill prevention and control plan to include ways to reduce the chance of spills, stop the source of spills, contain and clean up spills, dispose of materials contaminated by spills, and train personnel responsible for spill prevention and control. (For more information, see *SWPPP Guide*, Chapter 5, P2 Principle 6.)
- Also, see EPA's *Spill Prevention and Control Plan BMP Fact sheet* at www.epa.gov/npdes/stormwater/menuofbmps/construction/spill_control

Spill Prevention and Control Procedures

BMP Description:

- Employee Training: All employees will be trained via biweekly tailgate sessions.
- Vehicle Maintenance: Vehicles and equipment will be maintained off-site. All vehicles and equipment including subcontractor vehicles will be checked for leaking oil and fluids. Vehicles leaking fluids will not be allowed on-site. Drip pans will be placed under all vehicles and equipment that are parked overnight.
- Hazardous Material Storage: Hazardous materials will be stored in accordance with federal and municipal regulations.
- Spill Kits: Spill kits will be within the materials storage area.
- Spills: All spills will be cleaned up immediately upon discovery. Spent absorbent materials and rags will be hauled off-site immediately after the spill.
- The contractor is not to make this call. If there is a spill, notify MU EHS immediately at (573)-882-7018. MU EHS will make the determination as to whether or not to spill warrants a call to the NRC.

Installation Schedule:	The spill prevention and control procedures will be implemented once construction begins on-site.
Maintenance and Inspection:	All personnel will be instructed, during tailgate training sessions, regarding the correct procedures for spill prevention and control. Notices that state these practices will be posted in the office trailer, and the individual who manages day-to-day site operations will be responsible for seeing that these procedures are followed
Responsible Staff:	Contractor

3.7 Any Additional BMPs

MP Description: N/A	
Installation Schedule:	N/A
Maintenance and Inspection:	N/A
Responsible Staff:	Contractor

3.8 Allowable Non-Stormwater Discharge Management

Instructions:

- Identify all allowable sources of non-stormwater discharges that are not identified. The allowable non-stormwater discharges identified might include the following (see your permit for an exact list):
  - ✓ Waters used to wash vehicles where detergents are not used
  - ✓ Water used to control dust
  - ✓ Potable water including uncontaminated water line flushings
  - ✓ Routine external building wash down that does not use detergents
  - ✓ Pavement wash waters where spills or leaks of toxic or hazardous materials have not occurred (unless all spilled material has been removed) and where detergents are not used
  - ✓ Uncontaminated air conditioning or compressor condensate
  - ✓ Uncontaminated ground water or spring water
  - ✓ Foundation or footing drains where flows are not contaminated with process materials such as solvents
  - ✓ Uncontaminated excavation dewatering
  - ✓ Landscape irrigation
- Identify measures used to eliminate or reduce these discharges and the BMPs used to prevent them from becoming contaminated.
- For more information, see *SWPPP Guide*, Chapter 3.A.

List allowable non-stormwater discharges and the measures used to eliminate or reduce them and to prevent them from becoming contaminated:

Any changes in construction activities that produce other allowable non-stormwater discharges will be identified, and the SWPPP will be amended, and the appropriate erosion and sediment control will be implemented.

Water Used to Control Dust

BMP Description: Dust control will be implemented as needed once site grading has begun and during windy conditions (forecasted or actual wind conditions of 20 mph or greater) while site grading is occurring. Spraying of potable water at a rate of 300 gallons per acre or less will be performed by a mobile pressure-type distributor truck no more than three times a day during the months of May–September and once per day during the months of October–April or whenever the dryness of the soil warrants it.

Installation Schedule:	
Maintenance and Inspection:	
Responsible Staff:	Contractor

Landscape Irrigation

BMP Description: Irrigation waters will not be sprayed onto impermeable surfaces such as paved driveways and roads. Waters will be directed onto soil and lawns by using hoses and correctly sized sprinklers with adjustable spray patterns. To avoid discharges of irrigation waters, the sprinklers will have low-flow rates and increased watering time. The irrigated area will be inspected for excess watering and to adjust watering times and schedules.

Installation Schedule:	
Maintenance and Inspection:	
Responsible Staff:	Contractor

SECTION 4: SELECTING POST-CONSTRUCTION BMPs

Instructions:

- Describe all post-construction stormwater management measures that will be installed during the construction process to control pollutants in stormwater discharges after construction operations have been completed. Examples of post-construction BMPs include the following:
  - ✓ Biofilters
  - ✓ Detention/retention devices
  - ✓ Earth dikes, drainage swales, and lined ditches
  - ✓ Infiltration basins
  - ✓ Porous pavement
  - ✓ Other proprietary permanent structural BMPs
  - ✓ Outlet protection/velocity dissipation devices
  - ✓ Slope protection
  - ✓ Vegetated strips and/or swales
- Identify any applicable federal, state, local, or tribal requirements for design or installation.
- Describe how low-impact designs or smart growth considerations have been incorporated into the design.
- For any structural BMPs, you should have design specifications and details and refer to them. Attach them as appendices to the SWPPP or within the text of the SWPPP.
- For more information on this topic, see your state's stormwater manual.
- You might also want to consult one of the references listed in Appendix D of the *SWPPP Guide*.
- Visit the post-construction section of EPA's Menu of BMPs at: www.epa.gov/npes/menuofbmps

Vegetated Swale

BMP Description: The vegetated swale as described in Section 2 will remain as a permanent stormwater management structure for the site. The swale will convey runoff to an overflow inlet in the North-Est corner of the site.

Installation Schedule:	The vegetated swale will be installed before site grading begins.
Maintenance and Inspection:	See Section 2 for maintenance and inspection procedures for the vegetated swale. Following completion of site construction and final stabilization, maintenance and inspection
Responsible Staff:	Contractor

SECTION 5: INSPECTIONS

5.1 Inspections

Instructions:

- Identify the individual(s) responsible for conducting inspections and describe their qualifications. Reference or attach the inspection form that will be used.
- Describe the frequency that inspections will occur at your site including any correlations to storm frequency and intensity.
- Note that inspection details for particular BMPs should be included in Sections 2 and 3.
- You should also document the repairs and maintenance that you undertake as a result of your inspections. These actions can be documented in the corrective action log described in Part 5.3 below.
- For more on this topic, see *SWPPP Guide*, Chapters 6 and 8.
- Also, see suggested inspection form in Appendix B of the *SWPPP Guide*.

1. Inspection Personnel: Identify the person(s) who will be responsible for conducting inspections and describe their qualifications:

- Personnel selected to conduct inspections should be knowledgeable in the principles and practices of erosion and sediment controls.

2. Inspection Schedule and Procedures:

Describe the inspection schedules and procedures you have developed for your site (include frequency of inspections for each BMP or group of BMPs, indicate when you will inspect, e.g., before/during/and after rain events, spot inspections):

- Inspections of the site will be performed once every 7 days and within 24 hours of the end of a storm event of one-half inch or greater. The inspections will verify that all BMPs required in Sections 2 and 3 are implemented, maintained, and effectively minimizing erosion and preventing stormwater contamination from construction materials.
- After each inspection, the inspector completes an inspection report.

Describe the general procedures for correcting problems when they are identified. Include responsible staff and time frames for making corrections:

- Site inspections will be conducted as described in section IV, Item 11 of the MU Land Disturbance Permit MOR100039. If corrective actions are identified during the inspection, the qualified personnel will notify and submit a copy of the inspection report to the project manager of the site.
- Project manager of the site will be responsible for initiating the corrective action within 24 hours of the report and completing maintenance as soon as possible or before the next storm event. For any corrective actions requiring a SWPPP amendment or change to a stormwater conveyance or control design.

For a copy of the inspection report, see appendix E.

5.2 Delegation of Authority

Instructions:

- Identify the individual(s) or specifically describe the position where the construction site operator has delegated authority for the purposes of signing inspection reports, certifications, or other information.
- Attach the delegation of authority form that will be used.
- For more on this topic, see *SWPPP Guide*, Chapter 7.

Duly Authorized Representative(s) or Position(s):

All reports, including SWPPPs and inspection reports, generally must be signed by the construction site operator. The authorized representative is typically someone who has direct responsibility for implementing the SWPPP. If the operator chooses to designate an authorized representative, a signed letter or statement to that effect must be included in the SWPPP.

Site inspections shall be also conducted as described in section IV, Item 11 of the MU Land Disturbance Permit MOR100039.

Attach a copy of the signed delegation of authority form in Appendix K.

5.3 Corrective Action Log

Instructions:

- Create here, or as an attachment, a corrective action log. This log should describe repair, replacement, and maintenance of BMPs undertaken as a result of the inspections and maintenance procedures described above. Actions related to the findings of inspections should reference the specific inspection report.
- This log should describe actions taken, date completed and note the person that completed the work.

Corrective Action Log: see attached Appendix L – Corrective Action Log

SECTION 6: RECORDKEEPING AND TRAINING

6.1 Recordkeeping

Instructions:

- The following is a list of records you should keep at your project site available for inspectors to review:
- Dates of grading, construction activity, and stabilization (which is covered in Sections 2 and 3)
- A copy of the construction general permit (attach)
- The signed and certified NOI form or permit application form (attach)
- A copy of the letter from EPA or/the state notifying you of their receipt of your complete NOI/application (attach)
- Inspection reports (attach)
- Records relating to endangered species and historic preservation (attach)
- Check your permit for additional details
- For more on this subject, see *SWPPP Guide*, Chapter 6.C.

Records will be retained for a minimum period of at least 3 years after the permit is terminated.

Date(s) when major grading activities occur:
See Appendix I – Grading and Stabilization Activities Log

Date(s) when construction activities temporarily or permanently cease on a portion of the site:
See Appendix I – Grading and Stabilization Activities Log

Date(s) when an area is either temporarily or permanently stabilized:
See Appendix I – Grading and Stabilization Activities Log

6.2 Log of Changes to the SWPPP

Instructions:

- Create a log here, or as an attachment, of changes and updates to the SWPPP. You should include additions of new BMPs, replacement of failed BMPs, significant changes in the activities or their timing on the project, changes in personnel, changes in inspection and maintenance procedures, updates to site maps, and so on.

Log of changes and updates to the SWPPP
See Appendix G – SWPPP Amendment Log

6.3 Training

Instructions:

- Training your staff and subcontractors is an effective BMP. As with the other steps you take to prevent stormwater problems at your site, you should document the training that you conduct for your staff, for those with specific stormwater responsibilities (e.g. installing, inspecting, and maintaining BMPs), and for subcontractors.
- Include dates, number of attendees, subjects covered, and length of training.
- For more on this subject, see *SWPPP Guide*, Chapter 8.

Individual(s) Responsible for Training:

Describe Training Conducted:

- General stormwater and BMP awareness training for staff and subcontractors:

  Informal training will be conducted for all staff, including subcontractors, on the site. The training will be conducted primarily via tailgate sessions and will focus on avoiding damage to stormwater BMPs and preventing illicit discharges. The tailgate sessions will be conducted biweekly and will address the following topics: Erosion Control BMPs, Sediment Control BMPs, non-stormwater BMPs, Waste Management and Materials Storage BMPs, and Emergency Procedures specific to the construction site. (See Appendix J – SWPPP Training Log)

- Detailed training for staff and subcontractors with specific stormwater responsibilities:

  Formal training will be conducted to all staff and subcontractors with specific stormwater responsibilities, such as installing and maintaining BMPs. The formal training will cover all design and construction specifications for installing the BMPs and proper procedures for maintaining each BMP. Formal training will occur before any BMPs are installed on the site. (See Appendix J – SWPPP Training Log)

SECTION 7: FINAL STABILIZATION

Instructions:

- Describe procedures for final stabilization. If you complete major construction activities on part of your site, you can document your final stabilization efforts for that portion of the site. Many permits will allow you to then discontinue inspection activities in these areas (be sure to check your permit for exact requirements). You can amend or add to this section as areas of your project are finally stabilized.
- Update your site plans to indicate areas that have achieved final stabilization.
- Note that dates for areas that have achieved final stabilization should be included in Section 6, Part 6.1 of this SWPPP.
- For more on this topic, see *SWPPP Guide*, Chapter 9.

Permanent Seeding

BMP Description: Permanent seeding will be applied immediately after the final design grades are achieved on portions of the site but no later than 14 days after construction activities have permanently ceased. After the entire site is stabilized, any sediment that has accumulated will be removed and hauled off-site for disposal. Construction debris, trash and temporary BMPs (including silt fences, material storage areas, sanitary toilets, and inlet protection) will also be removed and any areas disturbed during removal will be seeded immediately.

Seedbed Preparation

a. In areas where disturbance results in subsoil being the final grade surface, topsoil will be spread over the finished area at minimum depth of 2 to 6 inches.

b. The seedbed will be free of large clods, rocks, woody debris and other objectionable materials

c. Fertilizer and lime will be applied to the seedbed according to the manufacturer's recommendations or soil tests (soil tests are omitted from this example SWPPP).

d. The top layer of soil will be loosened to a depth of 3–5 inches by raking, tilling, disking or other suitable means.

Grass Selection/Application

a. Common areas at the site will be stabilized with a mixture of Tall Fescue, Creeping Red Fescue and Redtop at an application rate of 30 pounds per acre or 0.95 pounds per 1,000 square feet. Lawns will be stabilized with a mixture of Kentucky Blue Grass and Creeping Red Fescue at an application rate of 100 pounds per acre or 2.3 pounds per 1,000 square feet.

b. Seed will be applied uniformly by hydroseeding or broadcasting. Where broadcasting is used, the seed will be covered with .25 inch of soil or less, by cultipacking or raking.

Mulching

a. Hydromulch will be applied immediately following seeding at an application rate of 90–100 pounds (2–3 bales) per 1,000 square feet.

Installation Schedule:	Portions of the site where construction activities have permanently ceased will be stabilized, as soon as possible but no later than 14 days after construction ceases.
Maintenance and Inspection:	All seeded areas will be inspected weekly during construction activities for failure and after storm events until a dense cover of vegetation has been established. If failure is noticed at the seeded area, the area will be reseeded, fertilized, and mulched immediately. After construction is completed at the site, permanently stabilized areas will be monitored until final stabilization is reached, as specified by the Land Disturbance Permit MOR 100039. Final stabilization shall be approved by University of Missouri site inspector.
Responsible Staff:	Contractor

SECTION 8: CERTIFICATION AND NOTIFICATION

Instructions:

- The SWPPP should be signed and certified by the construction operator(s). Attach a copy of the NOI and permit authorization letter received from EPA or the state in Appendix D.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name: _____ Title: _____

Signature: _____ Date: _____

SWPPP APPENDICES

Attach the following documentation to the SWPPP:

Appendix A – General Location Map

Appendix B – Site Maps

Appendix C – Construction General Permit

Appendix D – NOI and Acknowledgement Letter from EPA/State

Appendix E – Inspection Reports

Appendix F – Corrective Action Log (or in Part 5.3)

Appendix G – SWPPP Amendment Log (or in Part 6.2)

Appendix H – Subcontractor Certifications/Agreements

Appendix I – Grading and Stabilization Activities Log (or in Part 6.1)

Appendix J – Training Log

Appendix K – Corrective-Action Log

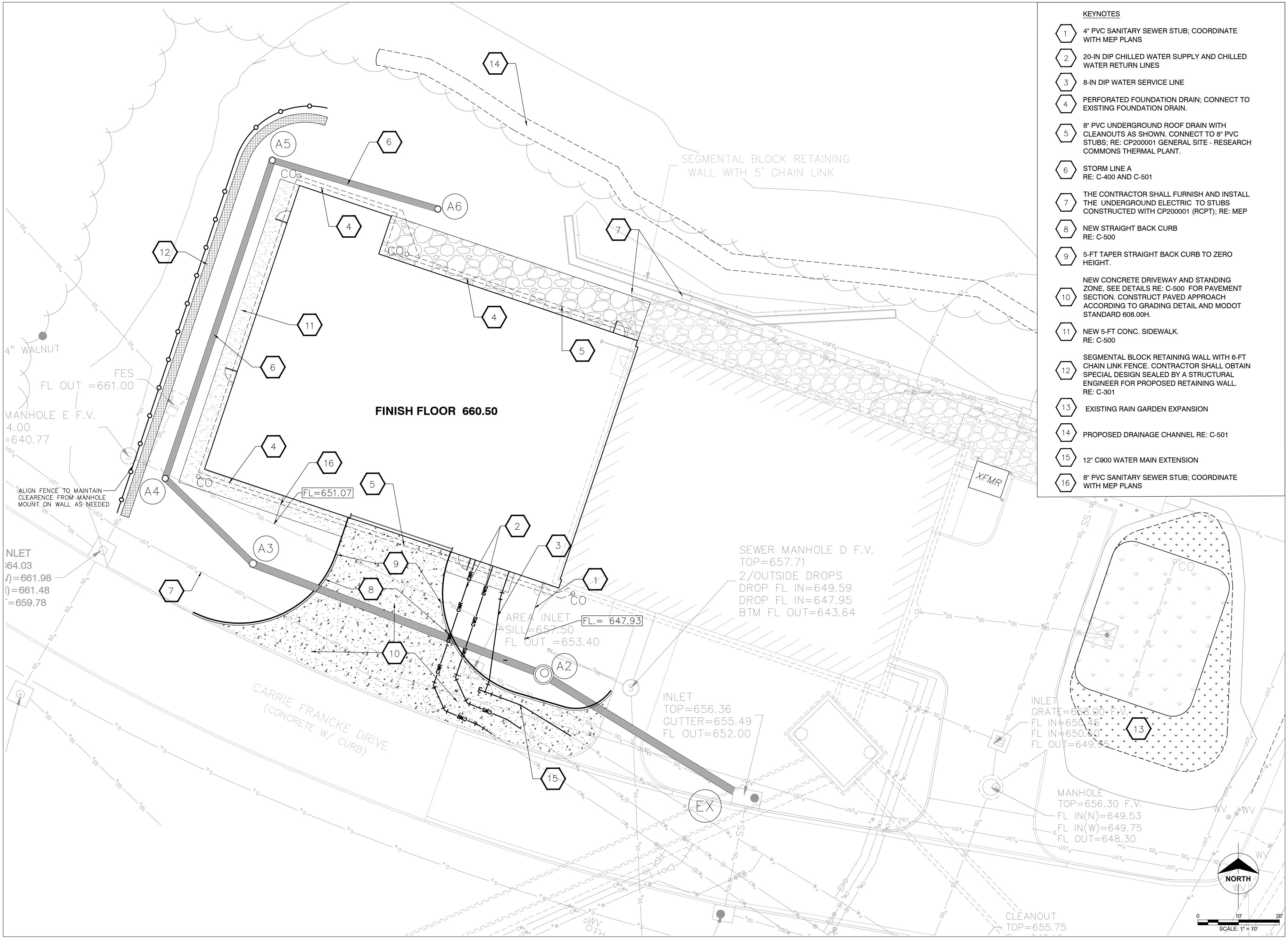
Appendix L – Delegation of Authority

Appendix M – Additional Information (i.e., Endangered Species and Historic Preservation Documentation)

Appendix A – GENERAL LOCATION MAP


PROJECT
LOCATION
Research Park Dr
Carrie Francke Dr
Research Park
Development Bldg
S Providence Rd
Melvin H. Marx Bldg
Carrie Francke Dr
163
Champi
Analytical Chemistry
Group MURR
Dalton Cardiovascular
Research Center
Research Park Dr
Laughlin Memorial Dr
American Red Cross
Blood Donation Center
Find a Blood Drive

Appendix B – SITE MAP



KEYNOTES

1. 4" PVC SANITARY SEWER STUB; COORDINATE WITH MEP PLANS
2. 20-IN DIP CHILLED WATER SUPPLY AND CHILLED WATER RETURN LINES
3. 8-IN DIP WATER SERVICE LINE
4. PERFORATED FOUNDATION DRAIN; CONNECT TO EXISTING FOUNDATION DRAIN.
5. 8" PVC UNDERGROUND ROOF DRAIN WITH CLEANOUTS AS SHOWN. CONNECT TO 8" PVC STUBS; RE: CP200001 GENERAL SITE - RESEARCH COMMONS THERMAL PLANT.
6. STORM LINE A RE: C-400 AND C-501
7. THE CONTRACTOR SHALL FURNISH AND INSTALL THE UNDERGROUND ELECTRIC TO STUBS CONSTRUCTED WITH CP200001 (RCPT); RE: MEP
8. NEW STRAIGHT BACK CURB RE: C-500
9. 5-FT TAPER STRAIGHT BACK CURB TO ZERO HEIGHT.
10. NEW CONCRETE DRIVEWAY AND STANDING ZONE, SEE DETAILS RE: C-500 FOR PAVEMENT SECTION. CONSTRUCT PAVED APPROACH ACCORDING TO GRADING DETAIL AND MODOT STANDARD 608.00H.
11. NEW 5-FT CONC. SIDEWALK. RE: C-500
12. SEGMENTAL BLOCK RETAINING WALL WITH 6-FT CHAIN LINK FENCE. CONTRACTOR SHALL OBTAIN SPECIAL DESIGN SEALED BY A STRUCTURAL ENGINEER FOR PROPOSED RETAINING WALL. RE: C-301
13. EXISTING RAIN GARDEN EXPANSION
14. PROPOSED DRAINAGE CHANNEL RE: C-501
15. 12" C900 WATER MAIN EXTENSION
16. 8" PVC SANITARY SEWER STUB; COORDINATE WITH MEP PLANS

THIS SHEET HAS BEEN SIGNED, SEALED, AND DATED ELECTRONICALLY

POWELL CWM — ARCHITECTURE | ENGINEERING | SURVEYING

B	09/10/24	ISSUED FOR CD REVIEW
A	06/18/24	ISSUED FOR DD REVIEW

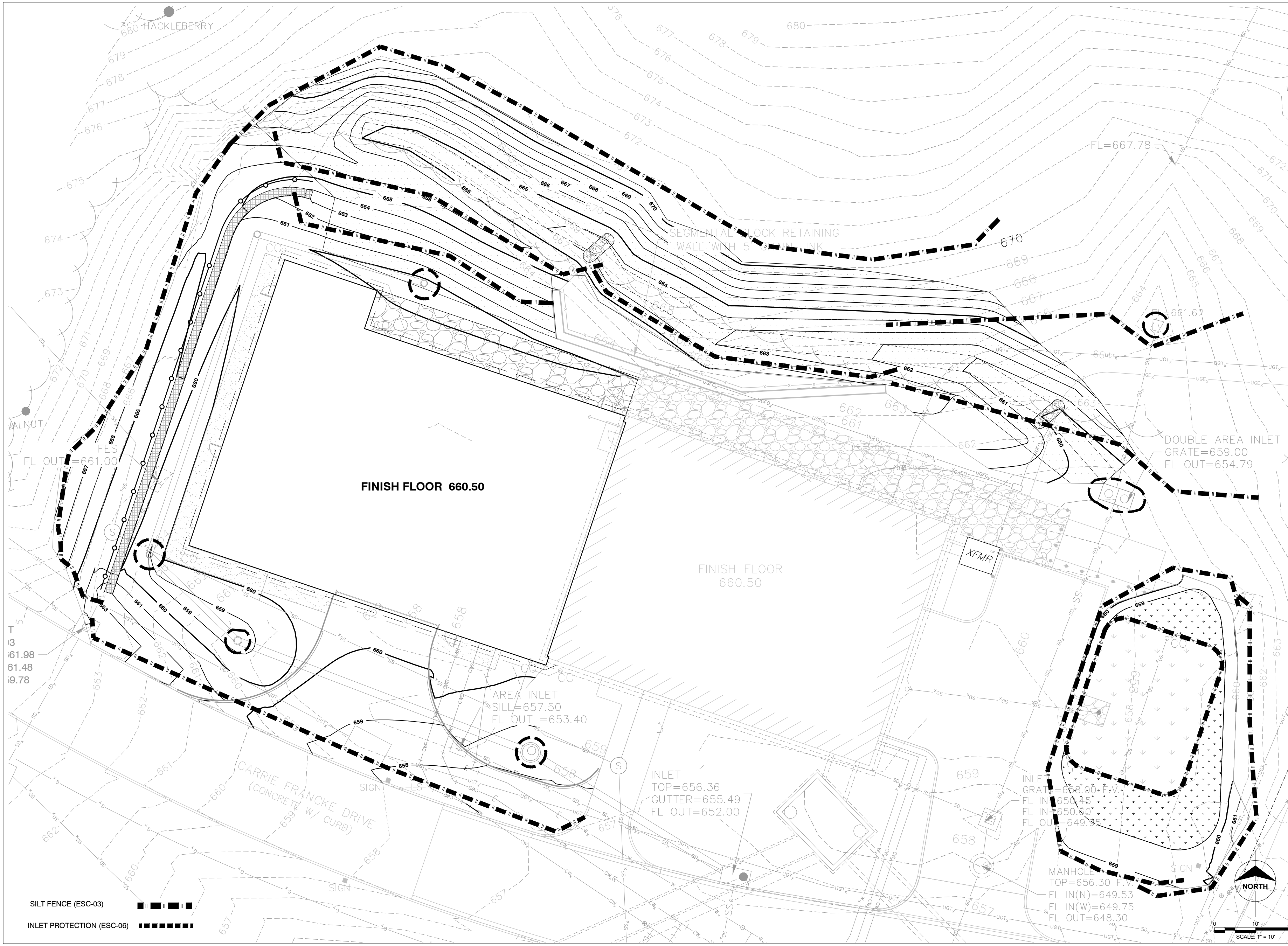
DRAWN BY: AIA CHECKED BY: JRT

PRVN CONSULTANTS, INC.
1617 Second Ave., Ste. 110
Rock Island, IL 61201
MISSOURI CERTIFICATE OF AUTHORITY ENGINEERING - 2023017605

UNIVERSITY OF MISSOURI - COLUMBIA
RESEARCH COMMONS THERMAL PLANT
CHILLED WATER PRODUCTION ADDITION
1404 CARRIE FRANCKE DRIVE, COLUMBIA, MO 65203
PROJECT NUMBER: CP232801
SITE PLAN

PROJECT NUMBER
CP232801

SHEET
C-200



THIS SHEET HAS BEEN SIGNED, SEALED, AND DATED ELECTRONICALLY

ENGINEER OF RECORD:
JADRIENNE S. RODELL-TIPTON, PE
PE-2021032725 (MISSOURI #)

Certificates of Authority
Architecture: MO 310 / KS 73
Engineering: MO 4 / KS 241
Land Surveying: MO 123 / KS 36

POWELL CWM
ARCHITECTURE/ENGINEERING/SURVEYING
3200 S. State Route 291, Bldg. 1, Independence, MO 64057
(816) 373-4800 | powellcwm.com

B	09/10/24	ISSUED FOR CD REVIEW
A	06/18/24	ISSUED FOR DD REVIEW

DRAWN BY: AIA CHECKED BY: JRT

PRVN CONSULTANTS, INC.
1617 Second Ave., Ste. 110
Rock Island, IL 61201
MISSOURI CERTIFICATE OF AUTHORITY ENGINEERING - 2023017605

UNIVERSITY OF MISSOURI - COLUMBIA
RESEARCH COMMONS THERMAL PLANT
CHILLED WATER PRODUCTION ADDITION
1404 CARRIE FRANCKE DRIVE, COLUMBIA, MO 65203
PROJECT NUMBER: CP232801

PROJECT NUMBER
CP232801

SHEET
C-301

Appendix C – CONSTRUCTION GENERAL PERMIT

Appendix D – NOI and acknowledgement Letter from EPA/State

Appendix E - Site Inspection Report

General Information			
Project Name			
Date of Inspection		**Start/End Time**	
Inspector's Name(s)			
Inspector's Contact Information			
Describe present phase of Construction			

Type of Inspection:
❑ Regular ❑ Pre-storm vent ❑ During storm event ❑ Post-storm event

Weather Information

Has there been a storm event since the last inspection? ❑Yes ❑No
If yes, provide:
Storm Start Date & Time: Storm Duration (hrs): Approximate Amount of Precipitation (in):

Weather at time of this inspection?
❑ Clear ❑Cloudy ❑ Rain ❑ Sleet ❑ Fog ❑ Snowing ❑ High Winds
❑ Other: Temperature:

Have any discharges occurred since the last inspection? ❑Yes ❑No
If yes, describe:

Are there any discharges at the time of inspection? ❑Yes ❑No
If yes, describe:

Site-specific BMPs

	BMP	BMP Installed?	BMP Maintenance Required?	Corrective Action Needed and Notes
1		❑Yes ❑No	❑Yes ❑No	
2		❑Yes ❑No	❑Yes ❑No	
3		❑Yes ❑No	❑Yes ❑No	
4		❑Yes ❑No	❑Yes ❑No	
5		❑Yes ❑No	❑Yes ❑No	
6		❑Yes ❑No	❑Yes ❑No	
7		❑Yes ❑No	❑Yes ❑No	
8		❑Yes ❑No	❑Yes ❑No	
9		❑Yes ❑No	❑Yes ❑No	
10		❑Yes ❑No	❑Yes ❑No	
11		❑Yes ❑No	❑Yes ❑No	
12		❑Yes ❑No	❑Yes ❑No	
13		❑Yes ❑No	❑Yes ❑No	
14		❑Yes ❑No	❑Yes ❑No	
15		❑Yes ❑No	❑Yes ❑No	
16		❑Yes ❑No	❑Yes ❑No	
17		❑Yes ❑No	❑Yes ❑No	
18		❑Yes ❑No	❑Yes ❑No	
19		❑Yes ❑No	❑Yes ❑No	
20		❑Yes ❑No	❑Yes ❑No	

Overall Site Issues

	BMP/activity	Implemented?	Maintenance Required?	Corrective Action Needed and Notes
1	Are all slopes and disturbed areas not actively being worked properly stabilized?	❑Yes ❑No	❑Yes ❑No	
2	Are natural resource areas (e.g., streams, wetlands, mature trees, etc.) protected with barriers or similar BMPs?	❑Yes ❑No	❑Yes ❑No	
3	Are perimeter controls and sediment barriers adequately installed (keyed into substrate) and maintained?	❑Yes ❑No	❑Yes ❑No	
4	Are discharge points and receiving waters free of any sediment deposits?	❑Yes ❑No	❑Yes ❑No	
5	Are storm drain inlets properly protected?	❑Yes ❑No	❑Yes ❑No	
6	Is the construction exit preventing sediment from being tracked into the street?	❑Yes ❑No	❑Yes ❑No	
7	Is trash/litter from work areas collected and placed in covered dumpsters?	❑Yes ❑No	❑Yes ❑No	

	BMP/activity	Implemented?	Maintenance Required?	Corrective Action Needed and Notes
8	Are washout facilities (e.g., paint, stucco, concrete) available, clearly marked, and maintained?	❑Yes ❑No	❑Yes ❑No	
9	Are vehicle and equipment fueling, cleaning, and maintenance areas free of spills, leaks, or any other deleterious material?	❑Yes ❑No	❑Yes ❑No	
10	Are materials that are potential stormwater contaminants stored inside or under cover?	❑Yes ❑No	❑Yes ❑No	
11	Are non-stormwater discharges (e.g., wash water, dewatering) properly controlled?	❑Yes ❑No	❑Yes ❑No	
12	(Other)	❑Yes ❑No	❑Yes ❑No	

Non-Compliance

Describe any incidents of non-compliance not described above:

CERTIFICATION STATEMENT

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Print name and title:

_____

Signature: _____

Date: _____

Appendix F – Corrective Action Log

Project Name:
SWPPP Contact:

Inspection Date	Inspector Name(s)	Description of BMP Deficiency	Corrective Action Needed (including planned date/responsible person)	Date Action Taken/Responsible person

Appendix G – SWPPP Amendment Log

Project Name:
SWPPP Contact:

Amendment No.	Description of the Amendment	Date of Amendment	Amendment Prepared by [Name(s) and Title]

Appendix H – Subcontractor Certifications/Agreements

SUBCONTRACTOR CERTIFICATION
STORMWATER POLLUTION PREVENTION PLAN

Project Number: _____

Project Title: _____

Operator(s): _____

As a subcontractor, you are required to comply with the Stormwater Pollution Prevention Plan (SWPPP) for any work that you perform on-site. Any person or group who violates any condition of the SWPPP may be subject to substantial penalties or loss of contract. You are encouraged to advise each of your employees working on this project of the requirements of the SWPPP. A copy of the SWPPP is available for your review at the office trailer.

Each subcontractor engaged in activities at the construction site that could impact stormwater must be identified and sign the following certification statement:

I certify under the penalty of law that I have read and understand the terms and conditions of the SWPPP for the above designated project and agree to follow the BMPs and practices described in the SWPPP.

This certification is hereby signed in reference to the above-named project:

Company: _____

Address: _____

Telephone Number: _____

Type of construction service to be provided: _____

_____

_____

Signature: _____

Title: _____

Date: _____

Appendix I – Grading and Stabilization Activities Log

Project Name:
SWPPP Contact:

Date Grading Activity Initiated	Description of Grading Activity	Date Grading Activity Ceased (Indicate Temporary or Permanent)	Date When Stabilization Measures are Initiated	Description of Stabilization Measure and Location

Appendix J – SWPPP Training Log

Stormwater Pollution Prevention Training Log

Project Name:

Project Location:

Instructor's Name(s):

Instructor's Title(s):

Course Location: _____ Date: _____

Course Length (hours): _____

Stormwater Training Topic: *(check as appropriate)*

- ❑ **Erosion Control BMPs**
- ❑ **Emergency Procedures**
- ❑ **Sediment Control BMPs**
- ❑ **Good Housekeeping BMPs**
- ❑ **Non-Stormwater BMPs**

Specific Training Objective:_____

_____

Attendee Roster: *(attach additional pages as necessary)*

No.	Name of Attendee	Company
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Appendix K – Delegation of Authority Form

Delegation of Authority

I, _____ (name), hereby designate the person or specifically described position below to be a duly authorized representative for the purpose of overseeing compliance with environmental requirements, including the Construction General Permit, at the _____ construction site. The designee is authorized to sign any reports, stormwater pollution prevention plans, and all other documents required by the permit.

_____ (name of person or position)
_____ (company)
_____ (address)
_____ (city, state, zip)
_____ (phone)

By signing this authorization, I confirm that I meet the requirements to make such a designation as set forth in _____ (Reference State Permit), and that the designee above meets the definition of a "duly authorized representative" as set forth in _____ (Reference State Permit).

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name: _____

Company: _____

Title: _____

Signature: _____

Date: _____

Appendix L - 2022 CGP Corrective Action Log

Project Name: _____

NPDES ID Number: _____

Section A – Individual Completing this Log	
Name:	**Title:**
Company Name:	**Email:**
Address:	**Phone Number:**
Section B – Details of the Problem (CGP Part 5.4.1.a) Complete this section within 24 hours of discovering the condition that triggered corrective action.	
Date problem was first identified:	**Time problem was first identified**:
What site conditions triggered this corrective action? *(Check the box that applies. See instructions for a description of each triggering condition (1 thru 6).)* ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5a ☐ 5b ☐ 6	
Specific location where problem identified:	
Provide a description of the specific condition that triggered the need for corrective action and the cause (if identifiable):	
Section C – Corrective Action Completion (CGP Part 5.4.1.b) Complete this section within 24 hours after completing the corrective action.	
For site condition # 1, 2, 3, 4, or 6 (those not related to a dewatering discharge) confirm that you met the following deadlines (CGP Part 5.2.1):	
☐ Immediately took all reasonable steps to address the condition, including cleaning up any contaminated surfaces so the material will not discharge in subsequent storm events. **AND**	
☐ Completed corrective action by the close of the next business day, unless a new or replacement control, or significant repair, was required. **OR**	
☐ Completed corrective action within seven (7) calendar days from the time of discovery because a new or replacement control, or significant repair, was necessary to complete the installation of the new or modified control or complete the repair. **OR**	
☐ It was infeasible to complete the installation or repair within 7 calendar days from the time of discovery. Provide the following additional information: Explain why 7 calendar days was infeasible to complete the installation or repair:	

Provide your schedule for installing the stormwater control and making it operational as soon as feasible after the 7 calendar days:

For site condition # 5a, 5b, or 6 (those related to a dewatering discharge), confirm that you met the following deadlines:

- ☐ Immediately took all reasonable steps to minimize or prevent the discharge of pollutants until a solution could be implemented, including shutting off the dewatering discharge as soon as possible depending on the severity of the condition taking safety considerations into account.
- ☐ Determined whether the dewatering controls were operating effectively and whether they were causing the conditions.
- ☐ Made any necessary adjustments, repairs, or replacements to the dewatering controls to lower the turbidity levels below the benchmark or remove the visible plume or sheen.

Describe any modification(s) made as part of corrective action: (Insert additional rows below if applicable)	**Date of completion:**	**SWPPP update necessary?**	**If yes, date SWPPP was updated:**
1.		☐ Yes ☐ No	
2.		☐ Yes ☐ No	

Section D - Signature and Certification (CGP Part 5.4.2)

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information contained therein. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information contained is, to the best of my knowledge and belief, true, accurate, and complete. I have no personal knowledge that the information submitted is other than true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

MANDATORY: Signature of Operator or "Duly Authorized Representative:"	
Signature:	**Date:**
Printed Name:	**Affiliation:**
OPTIONAL: Signature of Contractor or Subcontractor	
Signature:	**Date:**
Printed Name:	**Affiliation:**

Appendix M– Additional Information

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Boone County, Missouri

September 18, 2024

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:638 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 5 10 20 30

Feet
0 30 60 120 180

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Boone County, Missouri
Survey Area Data: Version 29, Aug 22, 2023

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 11, 2020—Nov 12, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
60035	Wrengart-Urban land complex, 9 to 14 percent slopes	1.4	100.0%
Totals for Area of Interest		**1.4**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Boone County, Missouri

60035—Wrengart-Urban land complex, 9 to 14 percent slopes

Map Unit Setting

National map unit symbol: 66ch
Elevation: 350 to 1,200 feet
Mean annual precipitation: 31 to 47 inches
Mean annual air temperature: 52 to 57 degrees F
Frost-free period: 170 to 228 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Wrengart and similar soils: 50 percent
Urban land: 35 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wrengart

Setting

Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loess over pedisediment over residuum weathered from cherty limestone

Typical profile

Ap - 0 to 7 inches: silty clay loam
Bt - 7 to 24 inches: silty clay loam
2Btx - 24 to 60 inches: silt loam
3Bt - 60 to 80 inches: gravelly clay

Properties and qualities

Slope: 9 to 14 percent
Depth to restrictive feature: 20 to 40 inches to undefined
Drainage class: Moderately well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 24 to 42 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Ecological site: F115XB005MO - Loamy Upland Woodland
Other vegetative classification: Trees/Timber (Woody Vegetation)
Hydric soil rating: No

Description of Urban Land

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

Minor Components

Bardley

Percent of map unit: 10 percent
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Weller

Percent of map unit: 5 percent
Landform: Interfluves, hillslopes
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve, side slope
Down-slope shape: Convex
Across-slope shape: Linear, convex
Ecological site: F115XB001MO - Deep Loess Upland Woodland
Hydric soil rating: No

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Custom Soil Resource Report
Map—Hydrologic Soil Group

Map Scale: 1:638 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 5 10 20 30

Feet
0 30 60 120 180

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
60035	Wrengart-Urban land complex, 9 to 14 percent slopes	D	1.4	100.0%
Totals for Area of Interest			**1.4**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

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Title
Segmental Retaining Walls - Product Data & Shop Drawings

Submittal Manager
Jeff Wilson

Spec Section
021200 - Segmental Retaining Walls

Type
None

Number
021200-001

Rev
0

Description
None

SHOP DRAWING / SUBMITTAL REVIEW

- ☐ No Exception Taken
- ☐ Exceptions Noted, Resubmittal Not Required
- ☐ Revise and Resubmit
- ☐ Rejected
- ☑ Reviewed for Information Only

DAVID MASON + ASSOCIATES
davidmason.com

Checking is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Any action shown is subject to the requirements of the plans and specifications. Contractor is responsible for: Dimensions which shall be confirmed and correlated at the job site, fabrication processes and techniques of the construction, coordination of his work with that of all other trades and the satisfactory performance of his work.

Reviewed By: M Davis

Date: 12/24/2024

UMC THERMAL PLANT RETAINING WALL

STRUCTURAL DESIGN HEREIN REPRESENTS A FINISHED STRUCTURE. THE GENERAL CONTRACTOR/OWNER SHALL PROVIDE ALL INTERIM BRACING, SHORING, INTERIM DRAINAGE PROVISIONS, DRAINAGE DIVERSION AND EROSION PROTECTION REQUIRED UNTIL FINAL CAPPING, PAVING, CURBING AND COMPLETION OF FINAL STORM DRAIN SYSTEM IS COMPLETE.

REV.	DATE	DESCRIPTION

ROSCH ENGINEERING
18390 WINGS CORPORATE DRIVE
CHESTERFIELD, MO 63005
PHONE: 636-519-7770
FAX: 636-532-7773
MO CERTIFICATE OF AUTHORITY #E-2012035063

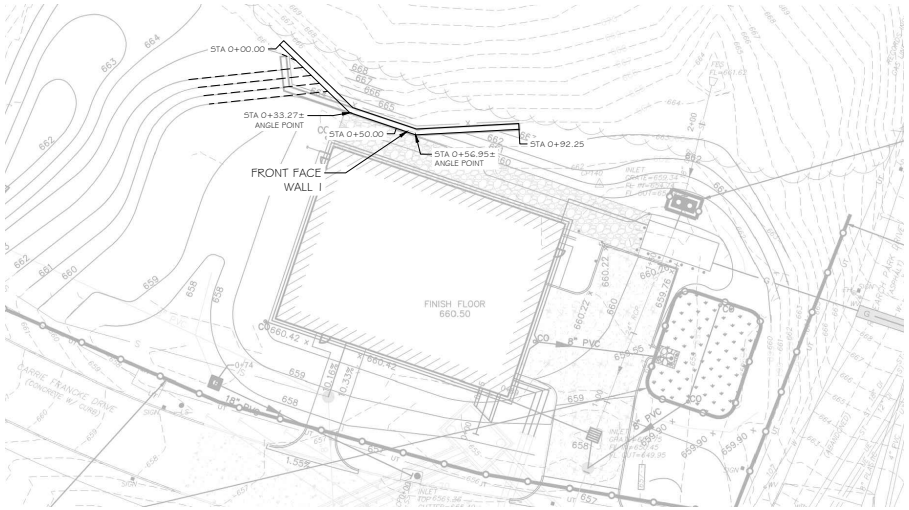
UMC THERMAL PLANT
COLUMBIA, MO
RETAINING WALL
COVER SHEET

STATE OF MISSOURI
BRIAN SCHALLER
E-28703
PROFESSIONAL ENGINEER

DESIGNED:	BCS
DRAWN:	JTM
DESIGN ENGINEER:	AMR
REVIEWED:	BCS
DATE:	12-3-24
JOB NO.:	24-0251
SHEET:	COVER

GRADING ASSUMED TO CONTINUE STRAIGHT TO NEW LOCATION OF WALL. CIVIL TO VERIFY

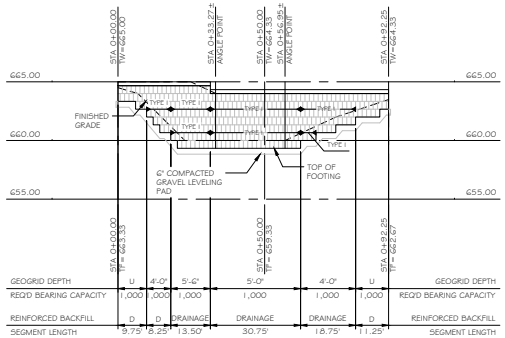
GRADING AS SHOWN IS ACCEPTABLE.



1 / P1 PLAN VIEW OF WALL 1
SCALE: 1"=20'-0"

THIS WALL PLAN IS INTENDED FOR GENERAL LOCATION PURPOSES ONLY. REFER TO PROJECT SITE PLANS FOR SPECIFIC DIMENSIONS.

N



2 / P1 WALL 1 ELEVATION
SCALE: 1"=20'-0" HORIZONTAL
SCALE: 1"=5'-0" VERTICAL

STORM PIPES, STORM STRUCTURES, LIGHT POLES BASES, ETC ARE SHOWN FOR INFORMATIONAL PURPOSES ONLY AND ARE BASED ON THE INFORMATION SHOWN ON THE PROJECT CIVIL PLANS REFERENCED IN GENERAL NOTE 1.4. REFER TO CURRENT PROJECT CIVIL PLANS FOR ALL SPECIFIC INFORMATION INCLUDING BUT NOT LIMITED TO SIZE AND LOCATION.

STRUCTURAL DESIGN HEREIN REPRESENTS A FINISHED STRUCTURE. THE GENERAL CONTRACTOR/OWNER SHALL PROVIDE ALL INTERIM BRACING, SHORING, INTERIM DRAINAGE PROVISIONS, DRAINAGE DIVERSION AND EROSION PROTECTION REQUIRED UNTIL FINAL CAPPING, PAVING, CURBING AND COMPLETION OF FINAL STORM DRAIN SYSTEM IS COMPLETE.

BLOCK PROPERTIES	
BLOCK TYPE	ROMANSTONE
BLOCK STYLE	BRUTUS

ASSUMED DESIGN SOIL PARAMETERS				
	DESCRIPTION	Φ (DEGREES)	γ (PCF)	c (PSF)
FOUNDATION SOIL	LEAN CLAY	25	120	50
RETAINED SOIL	LEAN CLAY	25	120	N/A
REINFORCED BACKFILL	DRAINAGE*	38	105	N/A

*SEE NOTES FOR ADDITIONAL INFORMATION

WALL PROPERTIES		
BACKSLOPE	**3:1 / 18.4°	H:V / DEGREES
TOESLOPE	/	H:V / DEGREES
BATTER	8.46	DEGREES
SETBACK	1.19	INCHES
SURCHARGE		
DEAD LOAD	0	PSF
LIVE LOAD	25	PSF

**BACK SLOPE VARIES - 3H:1V (18.4°) MAX

WALL ELEVATION NOTES:

1. GEOGRID DEPTH IS MEASURED FROM THE FRONT FACE OF BLOCK.
2. SEGMENT LENGTH IS THE DISTANCE BETWEEN GRID DEPTH TRANSITIONS
3. REINFORCED BACKFILL
   3.1. (D)RAINAGE ROCK, SEE DETAIL 1/D1
   3.2. (U)NREINFORCED, SEE DETAIL 2/D1
4. REQ'D BEARING CAPACITY IS IN PSF
5. ANGLE POINTS MAY BE CONSTRUCTED AS RADII.

REV	DATE	DESCRIPTION

ROSCH ENGINEERING
18390 WINGS CORPORATE DRIVE
CHESTERFIELD, MO 63005
PHONE: 636-519-7770
FAX: 636-532-7773
MO CERTIFICATE OF AUTHORITY #E-2012035063

UMC THERMAL PLANT
COLUMBIA, MO
RETAINING WALL
ELEVATION & PLAN

STATE OF MISSOURI
BRIAN SCHALLER
E-28703
PROFESSIONAL ENGINEER
12-3-2024

DESIGNED:	BCS
DRAWN:	JTM
DESIGN ENGINEER:	AMR
REVIEWED:	BCS
DATE:	12-3-24
JOB NO.:	24-0251
SHEET:	P1

GENERAL NOTES:

1. RETAINING WALL DESIGN:
 1.1. STRUCTURAL DESIGN HEREIN REPRESENTS A FINISHED STRUCTURE. THE GENERAL CONTRACTOR/OWNER SHALL PROVIDE ALL INTERIM BRACING, SHORING, INTERIM DRAINAGE PROVISIONS, DRAINAGE DIVERSION AND EROSION PROTECTION REQUIRED UNTIL FINAL CAPPING, PAVING, CURBING AND COMPLETION OF FINAL STORM DRAIN SYSTEM.
  1.1.1. IT IS THE RESPONSIBILITY OF THE GENERAL CONTRACTOR/OWNER TO ENSURE THAT THE FINISHED SITE DRAINAGE IS DIRECTED AWAY FROM THE RETAINING WALL SYSTEM.
  1.1.2. IT IS THE RESPONSIBILITY OF THE GENERAL CONTRACTOR/OWNER TO ENSURE THAT THE SURFACE WATER RUNOFF FROM ADJACENT CONSTRUCTION AREAS IS NOT ALLOWED TO ENTER THE RETAINING WALL AREA OF THE CONSTRUCTION SITE.

 1.2. THE PROJECT GEOTECHNICAL ENGINEER SHALL REVIEW THESE DRAWINGS TO CONFIRM THE ASSUMPTIONS MEET THE INTENT OF THE GEOTECHNICAL REPORT. ADDITIONALLY, THE PROJECT GEOTECHNICAL ENGINEER SHALL REVIEW GLOBAL STABILITY OF THE RETAINING WALLS AND PROVIDE RECOMMENDATIONS AS NEEDED.

 1.3. THE DESIGN OF THE SEGMENTAL RETAINING WALLS IS IN ACCORDANCE WITH NCMA DESIGN MANUAL FOR SEGMENTAL RETAINING WALLS 3RD EDITION AND NCMA'S SEGMENTAL RETAINING WALLS BEST PRACTICES GUIDE AND INCLUDES EXTERNAL STABILITY; SLIDING AND OVERTURNING OF THE REINFORCED MASS, AND INTERNAL STABILITY; PULLOUT, CONNECTION STRENGTH AND TENSILE STRENGTH OF THE GEOGRID AS WELL AS FACIAL STABILITY OF THE FACE UNITS. THE APPLIED BEARING PRESSURES ARE LISTED ON THE INDIVIDUAL WALL PROFILES.

 1.4. SCOPE OF DESIGN SERVICES ARE LIMITED TO THOSE DEFINED FOR "SRW (RETAINING WALL) ENGINEER" IN THE NCMA BEST PRACTICES MANUAL (2017) AND NCMA TEK 15-03A. ALL OTHER ENGINEERING SERVICES ARE EXCLUDED.

 1.5. THE DESIGN OF THE SEGMENTAL RETAINING WALLS IS BASED ON THE FOLLOWING DOCUMENTS:

  DRAWING C-500 DATED 3/10/2023 PREPARED BY RODGERS-SCHMIDT ENGINEERING CO., P.C.

 1.6. THE DESIGN OF THE SEGMENTAL RETAINING WALL IS BASED ON THE INDIVIDUAL SOIL PROPERTIES AS LISTED WITHIN THESE PLANS AS WELL AS THE FOLLOWING CRITERIA:

  SEISMIC ACCELERATION = N/A
  GROUND WATER LOCATION = 2H/3 BELOW THE TOP OF LEVEL PAD (WHERE H = HEIGHT OF WALL)
  HYDROSTATIC LOADING = NONE
  SURCHARGE LOADING = SEE WALL ELEVATION(S)

2. SETTLEMENT:
 2.1. SEGMENTAL RETAINING WALLS ARE FLEXIBLE MASSES THAT CAN TOLERATE MINOR SETTLEMENT. SETTLEMENT SENSITIVE RIGID MASSES FOUNDED ON OR ABOVE THE SEGMENTAL RETAINING WALL SHOULD BE REVIEWED AND, IF REQUIRED, A SETTLEMENT ANALYSIS SHOULD BE PERFORMED BY THE PROJECT GEOTECHNICAL ENGINEER. SETTLEMENT ANALYSIS IS OUTSIDE OF ROSCH ENGINEERING'S SCOPE OF WORK.

3. MATERIAL PROPERTIES:
 3.1. SEGMENTAL CONCRETE WALL UNITS SHALL BE MANUFACTURED IN ACCORDANCE WITH ASTM C1372 HAVING A MINIMUM 28-DAY COMPRESSIVE STRENGTH OF 3,000 PSI AND A MAXIMUM MOISTURE ABSORPTION OF 8%. ALL UNITS SHALL BE SOUND AND FREE OF CRACKS OR OTHER DEFECTS THAT WOULD INTERFERE WITH THE PROPER PLACING OF THE UNIT OR SIGNIFICANTLY IMPAIR THE STRENGTH OR PERFORMANCE OF THE CONSTRUCTION.

 3.2. DRAINAGE ROCK SHALL BE A CLEAN CRUSHED STONE OR GRANULAR FILL SUCH AS 1" OR 2" CLEAN MEETING THE FOLLOWING GRADATION AS DETERMINED IN ACCORDANCE WITH ASTM D 422:

SIEVE SIZE	PERCENT PASSING
1 INCH - 2 INCH	100
¾ INCH	75-100
NO. 4	0-60
NO. 40	0-50
NO. 200	0-5

 3.3. COMPACTED ROCK SHALL BE FREE OF ORGANIC MATERIAL. THE ROCK SHALL BE A WELL GRADED GRAVEL OR LIMESTONE MEETING THE FOLLOWING GRADATION AS DETERMINED IN ACCORDANCE WITH ASTM D 422 AND A Pl<6:

SIEVE SIZE	PERCENT PASSING
1 INCH	100
NO. 4	20-100
NO. 40	0-60
NO. 200	0-15

 3.4. LOW PERMEABLE SOIL SHALL CONSIST OF MATERIAL HAVING A MINIMUM PLASTICITY INDEX OF 10. NO MORE THAN 10% SHALL BE RETAINED ON A NO. 4 SIEVE AND NO LESS THAN 35% SHALL PASS A NO. 200 SIEVE. MATERIAL WITH A USC DESIGNATION OF ML, CL, OR OL ARE ACCEPTABLE FOR USE AS LOW PERMEABLE SOIL.

 3.5. THE GEOGRID SHALL BE A HIGH DENSITY POLYETHYLENE EXPANDED SHEET OR POLYESTER WOVEN FIBER MATERIAL, SPECIFICALLY FABRICATED FOR USE AS SOIL REINFORCEMENT. ACCEPTABLE GEOGRID TYPES AND MANUFACTURER AS FOLLOWS:
  TYPE I:
   SF35 BY SYNTEEN TECHNICAL FABRICS, INC.
   SGU 60 BY STRATA SYSTEMS, INC.
   MIRAGRID 3XT AS MANUFACTURED BY TENCATE GEOSYNTHETICS.
   HP200 AS MANUFACTURED BY GEOSTAR TECHNOLOGIES, LLC.

 3.6. GEOTEXTILE FILTER FABRIC SHALL BE A NONWOVEN GEOTEXTILE COMPOSED OF POLYPROPYLENE FIBERS WITH A MINIMUM FLOW RATE OF 140 GPM/FT² WHEN TESTED ACCORDING TO ASTM D 4491.

 3.7. DRAINAGE PIPE SHALL BE A 4"Ø PERFORATED OR SLOTTED PVC OR CORRUGATED HDPE PIPE.

 3.8. DRAINAGE PIPE SHALL BE MANUFACTURED IN ACCORDANCE WITH ASTM F 405 OR ASTM F 758.

 3.9. CONSTRUCTION ADHESIVE SHALL BE EXTERIOR GRADE ADHESIVE AS RECOMMENDED BY THE SEGMENTAL CONCRETE WALL UNIT MANUFACTURER.

4. EXCAVATION:
 4.1. THE CONTRACTOR SHALL EXCAVATE TO THE LINES AND GRADES SHOWN ON THE PLANS. THE GENERAL CONTRACTOR SHALL TAKE PRECAUTIONS TO MINIMIZE OVER-EXCAVATION.

 4.2. EXCAVATION SUPPORT, INCLUDING THE STABILITY OF THE EXCAVATION AND ITS INFLUENCE ON ADJACENT PROPERTY IS THE RESPONSIBILITY OF THE GENERAL CONTRACTOR.

5. FOUNDATION SOIL PREPARATION:
 5.1. FOLLOWING EXCAVATION FOR THE LEVELING PAD AND THE REINFORCED SOIL ZONE, FOUNDATION SOIL SHALL BE EXAMINED BY THE OWNER'S GEOTECHNICAL ENGINEER TO ASSURE THE ACTUAL FOUNDATION SOIL STRENGTH MEETS OR EXCEEDS THE REQUIRED BEARING STRENGTH. SOIL NOT MEETING THE REQUIRED STRENGTH SHALL BE REMOVED AND REPLACED WITH SOIL MEETING THE DESIGN CRITERIA, AS DIRECTED BY THE OWNER'S GEOTECHNICAL ENGINEER.

 5.2. IF HIGH PLASTIC SOILS ARE ENCOUNTERED IN THE FOUNDATION ZONE OF ANY RETAINING WALL, IT SHALL BE REMEDIATED SIMILAR TO ANY BUILDING FOUNDATION, AS DIRECTED BY THE PROJECT GEOTECHNICAL ENGINEER.

 5.3. FOUNDATION SOIL IS DEFINED AS THE SOIL UNDER THE SEGMENTAL RETAINING WALL VOLUME, EXTENDING FROM THE TOE OF THE LEVELING PAD TO THE BACK OF THE REINFORCED MASS.

6. BASE LEVELING PAD INSTALLATION:
 6.1. LEVELING PAD SHALL BE PLACED AS SHOWN ON THE DRAWINGS AND CONSIST OF EITHER:
  LEAN CONCRETE (2,000 PSI) - 6" MINIMUM THICK
  WELL GRADED 1" GRAVEL OR DRAINAGE ROCK WITH FINES - 6" MINIMUM THICK.

 6.2. SAND OR GRAVEL BASE SHALL BE COMPACTED WITH 3 PASSES OF A VIBRATORY COMPACTOR TO PROVIDE A FIRM, LEVEL BEARING PAD.

 6.3. LEAN CONCRETE SHALL CURE A MINIMUM OF 12 HOURS PRIOR TO UNIT PLACEMENT.

 6.4. LEVELING PAD SHALL BE CONSTRUCTED TO INSURE FULL BEARING OF RETAINING WALL UNITS.

7. UNIT INSTALLATION:
 7.1. THE FIRST COURSE OF SEGMENTAL CONCRETE WALL UNITS SHALL BE PLACED ON THE LEVELING PAD AND CHECKED FOR LEVEL, ALIGNMENT, AND FULL CONTACT WITH BASE.

 7.2. UNITS SHALL BE PLACED SIDE BY SIDE FOR FULL LENGTH OF WALL. ALIGNMENT SHALL BE DONE BY MEANS OF A STRING LINE OR OFFSET MEASUREMENT FROM BASE LINE.

 7.3. PLACE DRAINAGE AGGREGATE WITHIN THE BLOCK CORES DIRECTLY BEHIND AND BETWEEN THE UNITS AS SHOWN IN DETAILS. WHERE THE REINFORCED BACKFILL IS COMPACTED ROCK, PLACE REINFORCED BACKFILL DIRECTLY AGAINST DRAINAGE FILL. CONSOLIDATE DRAINAGE AGGREGATE WITH 2 PASSES OF A VIBRATORY COMPACTOR. COMPACTION TESTING OF DRAINAGE AGGREGATE IS NOT REQUIRED. EXCESS MATERIAL SHALL BE REMOVED FROM TOP OF UNITS PRIOR TO INSTALLATION OF NEXT COURSE.

 7.4. LAY UP EACH COURSE INSURING POSITIVE CONTACT BETWEEN PREVIOUS COURSE IS ACHIEVED.

8. GEOGRID INSTALLATION:
 8.1. GEOGRID SHALL BE LAID AT THE PROPER ELEVATION AND ORIENTATION AS SHOWN ON THE DRAWINGS.

 8.2. THE GEOGRID REINFORCEMENT SHALL BE LAID HORIZONTALLY ON LEVEL, COMPACTED BACKFILL, AND EMBEDDED IN THE BLOCK.

 8.3. PLACE GEOGRID ON CONCRETE WALL UNITS, PLACE THE NEXT COURSE OF UNITS, PLACE THE DRAINAGE FILL, PULL GEOGRID TIGHT PRIOR TO BACKFILLING.

 8.4. CORRECT ORIENTATION OF THE GEOGRID SHALL BE VERIFIED.

 8.5. 3" OF REINFORCED BACKFILL SHALL BE PLACED BETWEEN ALL LOCATIONS OF OVERLAPPING GEOGRID.

9. BACKFILL PLACEMENT:
 9.1. REINFORCED BACKFILL MATERIAL SHALL BE PLACED IN 8" MAXIMUM LIFTS.

 9.2. COMPACTED ROCK SHALL BE COMPACTED TO A MINIMUM 95% OF STANDARD PROCTOR DENSITY PER ASTM 698 UNLESS NOTED OTHERWISE ON THE INDIVIDUAL WALL PROFILES.

 9.3. DRAINAGE ROCK SHALL BE COMPACTED WITH A MINIMUM OF 2 PASSES OF A VIBRATORY COMPACTOR. FIELD DENSITY TESTING WILL NOT BE REQUIRED FOR DRAINAGE ROCK.

 9.4. ONLY LIGHTWEIGHT HAND-OPERATED COMPACTION EQUIPMENT SHALL BE USED WITHIN 3' OF THE BACK FACE OF BLOCK.

 9.5. REINFORCED BACKFILL SHALL BE PLACED, SPREAD, AND COMPACTED IN SUCH A MANNER THAT ELIMINATES THE DEVELOPMENT OF WRINKLES AND/OR MOVEMENT OF THE GEOGRID.

 9.6. REINFORCED BACKFILL SHALL BE PLACED AND COMPACTED FROM THE BACK OF THE WALL REARWARD INTO THE EMBANKMENT TO INSURE THAT THE GEOGRID REMAINS TIGHT.

 9.7. TRACKED CONSTRUCTION EQUIPMENT SHALL NOT BE OPERATED DIRECTLY ON THE GEOGRID. A MINIMUM BACKFILL THICKNESS OF 6" SHALL BE MAINTAINED TO OPERATE TRACKED VEHICLES OVER THE GEOGRID. TURNING OF TRACKED CONSTRUCTION EQUIPMENT SHALL BE KEPT TO A MINIMUM TO PREVENT TRACKS FROM DISPLACING THE FILL AND DAMAGING THE GEOGRID.

 9.8. AT THE END OF EACH DAY'S OPERATION, SLOPE THE LAST LEVEL OF COMPACTED BACKFILL AWAY FROM THE INTERIOR (CONCEALED) FACE OF THE WALL TO DIRECT SURFACE WATER RUNOFF FROM THE WALL FACE.
  9.8.1. IT IS THE RESPONSIBILITY OF THE GENERAL CONTRACTOR TO ENSURE THE FINISHED SITE DRAINAGE IS DIRECTED AWAY FROM THE RETAINING WALL SYSTEM.
  9.8.2. IT IS THE RESPONSIBILITY OF THE GENERAL CONTRACTOR TO ENSURE THE SURFACE WATER RUNOFF FROM ADJACENT CONSTRUCTION AREAS IS NOT ALLOWED TO ENTER THE RETAINING WALL AREA OF THE CONSTRUCTION SITE.

10. DRAIN PIPE INSTALLATION:
 10.1. DRAINAGE COLLECTION PIPES SHALL BE INSTALLED TO MAINTAIN GRAVITY FLOW OF WATER OUTSIDE OF THE REINFORCED SOIL ZONE. THE DRAINAGE COLLECTION PIPE SHOULD CONNECT INTO A STORM SEWER MANHOLE OR DAYLIGHT THROUGH THE FACE OF THE WALL.

11. CAP INSTALLATION:
 11.1. CAP UNITS SHALL BE ADHERED TO THE TOP UNITS USING MANUFACTURER SUPPLIED ADHESIVE BY PLACING TWO 1/4" BEADS OF ADHESIVE ON EACH UNIT ALONG THE ENTIRE LENGTH OF THE WALL. PRESS THE CAP UNITS FIRMLY INTO THE ADHESIVE AND ALLOW TO CURE.

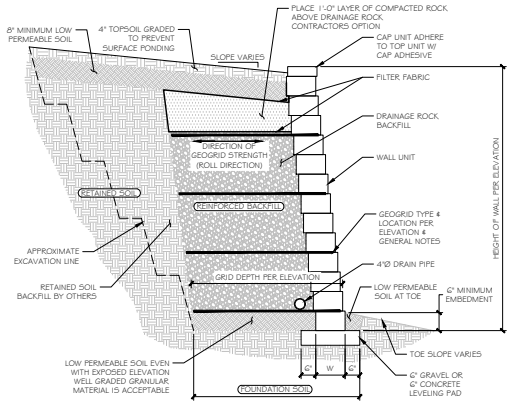
12. FIELD QUALITY CONTROL:
 12.1. THE OWNER OR OWNER'S REPRESENTATIVE IS RESPONSIBLE FOR ENGAGING THE SERVICES OF AN INDEPENDENT THIRD PARTY INSPECTOR TO OBSERVE AND VERIFY ALL SOIL PROPERTIES AS WELL AS VERIFY CORRECT INSTALLATION OF ALL SYSTEM COMPONENTS TO MEET THE REQUIREMENTS OF THESE GENERAL NOTES AND DRAWINGS.

 12.2. TESTING METHODS, FREQUENCY AND VERIFICATION OF MATERIAL SPECIFICATIONS SHALL BE THE RESPONSIBILITY OF THE INDEPENDENT THIRD PARTY INSPECTOR. AT A MINIMUM, COMPACTION TESTING SHALL INCLUDE ONE COMPACTION TEST FOR EACH LIFT BUT NOT LESS THAN ONE TEST FOR EVERY 50 CUBIC YARDS OF COMPACTED FILL AT A SPACING NOT TO EXCEED 100'.

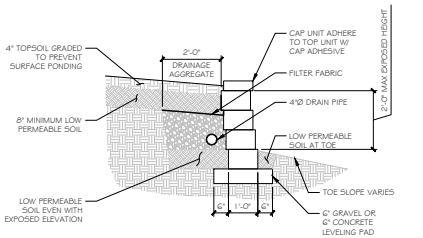
13. ABBREVIATIONS:

FGE	FINISHED GRADE EXTERIOR
FGI	FINISHED GRADE INTERIOR
FL	FLOW LINE
MAX	MAXIMUM
MIN	MINIMUM
OC	ON CENTER
PL	PROPERTY LINE
STA	STATION
TF	TOP OF FOOTING ELEVATION
TW	TOP OF WALL ELEVATION
TYP	TYPICAL
UNO	UNLESS NOTED OTHERWISE

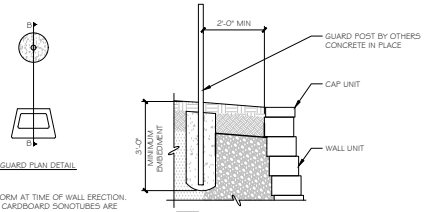
ROSCH ENGINEERING HAS PERFORMED DESIGN CALCULATIONS BASED ON THE DESIGN CRITERIA, ASSUMED SOIL PARAMETERS, AND KNOWN LOADING CONDITIONS AS LISTED IN THESE DRAWINGS. THE OWNER'S REPRESENTATIVE, INDEPENDENT THIRD PARTY SPECIAL INSPECTOR AND INSTALLER SHALL NOTIFY ROSCH ENGINEERING OF ANY CHANGES OR DIFFERENCES IN ACTUAL SITE CONDITIONS WHICH VARY FROM THOSE LISTED, PRIOR TO CONSTRUCTING THE WALL.



1 D1 TYPICAL SECTION - DRAINAGE ROCK
NTS

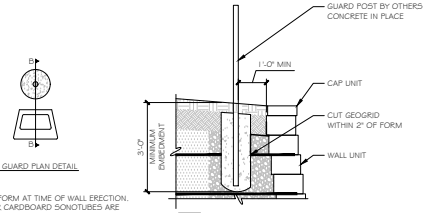


2 D1 TYPICAL SECTION - UNREINFORCED WALL
NTS



NOTES:
1. PLACE FORM AT TIME OF WALL ERECTION.
2. PVC OR CARDBOARD SONOTUBES ARE ACCEPTABLE FORMS.
3. FENCE DESIGN AND SUITABILITY IS THE RESPONSIBILITY OF OTHERS.

3 D1 TYPICAL POST AT UNREINFORCED WALL
NTS



NOTES:
1. PLACE FORM AT TIME OF WALL ERECTION.
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3. FENCE DESIGN AND SUITABILITY IS THE RESPONSIBILITY OF OTHERS.

4 D1 TYPICAL POST AT REINFORCED WALL
NTS

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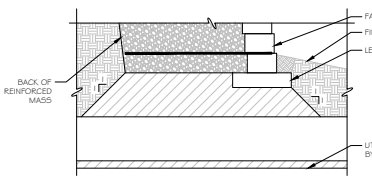
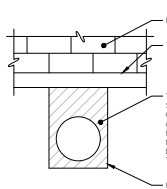
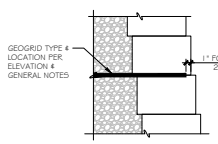
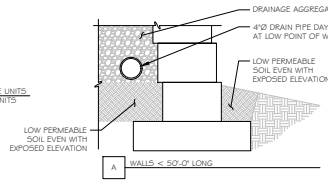


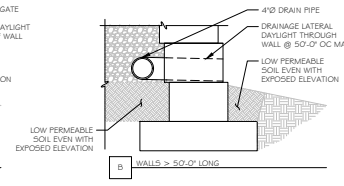


5 D1 UTILITY TRENCH CROSSING DETAIL
NTS



6 D1 GEOGRID PLACEMENT
NOT TO SCALE





7 D1 DRAIN PIPE INSTALLATION
NOT TO SCALE

THESE PLANS ARE FOR THE EXCLUSIVE USE OF ROSCH CONSTRUCTION. USE OF THESE PLANS BY ANY OTHER ENTITY TO CONSTRUCT THE SUBJECT STRUCTURES WILL RENDER THE ENGINEERING SEAL SHOWN NULL AND VOID.

REV	DATE	DESCRIPTION

ROSCH ENGINEERING
18390 WINGS CORPORATE DRIVE
CHESTERFIELD, MO 63005
PHONE: 636-519-7770
FAX: 636-532-7773
MO CERTIFICATE OF AUTHORITY #E-2012035063

UMC THERMAL PLANT
COLUMBIA, MO
RETAINING WALL
NOTES & DETAILS

STATE OF MISSOURI
BRIAN SCHALLER
E-28703
PROFESSIONAL ENGINEER
12-3-2024

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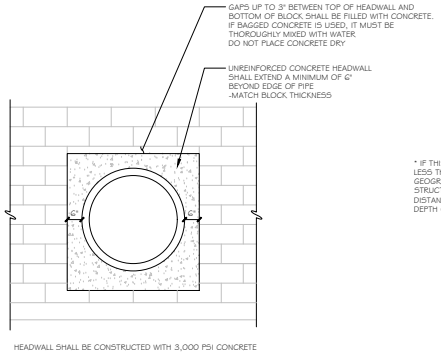
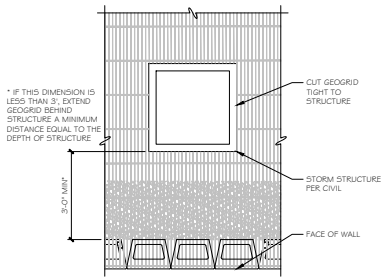
SHEET:	D1



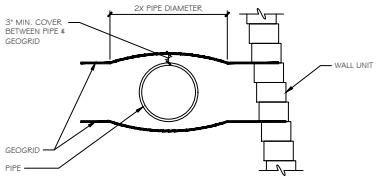
1 D2 TYPICAL CONCRETE HEADWALL

NTS



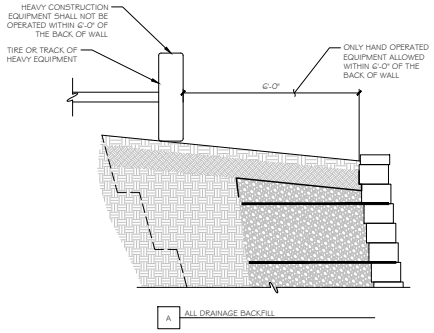
2 D2 TYPICAL SECTION - AT STRUCTURE

NTS



3 D2 TYPICAL SECTION - AT PIPE

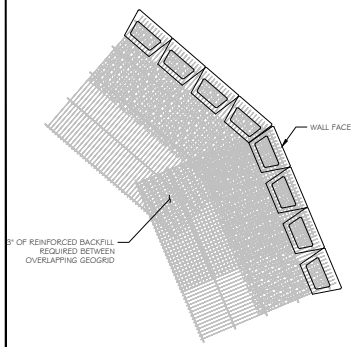
NTS



4 D2 HEAVY EQUIPMENT AT TOP OF WALL

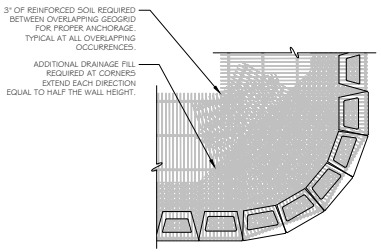
NTS

SEE DETAIL 1/D1 FOR ADDITIONAL INFORMATION NOT SHOWN



5 D1 ANGLE POINT DETAIL

NTS



6 D2 TYPICAL CONCAVE CORNER DETAIL

NTS

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RETAINING WALL DETAILS

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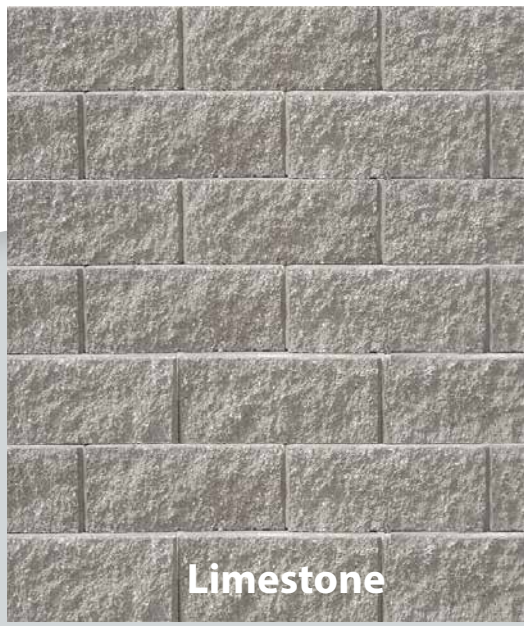
JOB NO.:	24-0251
SHEET:	D2

AMERICAN MADE

Brutus™



Limestone

Stable. Affordable. Architectural.

Brutus™ is your best option for high performance walls where great looks is as much a priority as great performance and great value. The straight split featured on Brutus™ gives the block a clean architectural look that complements many structures. The square foot size and rear lip connection allows for fast and easy installation.

KEYSTONE® HARDSCAPES

Steps to Installing Brutus™

AMERICAN MADE

Step 1 - Foundation

Lay out your wall project with string line or spray paint. Dig a trench at least 12" deep by 24" wide and compact the soil. Add and compact a 6" layer of crushed stone to create a level footing. Do this in two 3" lifts. If the grade changes, step the leveling pad as required with the top of the pad always at least 6" below finish grade.

Step 2 - Base Course

Place and level the first course of Brutus™ wall units on the leveling pad. The rear lips on the first course of block can be removed to allow the units to lay flat on the crushed stone. Use a string line to align straight sections. Start from any corner and work out from there. Add soil in front and back of the base course and compact to finish grade. Complete the first course of wall units before installing additional courses.

Step 3 - Backfill and Additional Courses

Install additional Brutus™ units over the vertical joint of the blocks in the course below it to maintain a running bond. Pull the units forward to engage the rear lips and maintain a setback from the course below. Backfill and compact clean crushed stone behind each wall course before installing the next course. Complete your wall with a cap unit secured to the wall with concrete adhesive. Cut any cap as needed to fit radius walls.

Brutus™

Romanstone Brutus™ features our improved lip design resulting in less breakage, easier installation and reduced waste. The core-fill design results in lighter weight, more square foot per truck load, and easier installation.

Notes:

Brutus units have a setback of 1-3/16" per course. This creates an 8.3° wall batter. This setback will shift the bond lines of your wall when curves are built. If the vertical joints become stacked, part of the rear lip can be removed or units can be cut to get back to a running bond.

Estimating Chart

Wall Height	Wall length				
	12′	18′	24′	36′	75′
8" (1 course)	8	12	18	24	50
16" (2 courses)	16	24	36	48	100
24" (3 courses)	24	36	54	72	150
32" (4 courses)	32	48	72	96	200
40" (5 courses)	40	60	90	120	250
48" (6 courses)	48	72	108	144	300
56" (7 courses)	56	84	126	168	350

- Unit dimensions: 8"H x 18"W x 12"D
- Units per square foot: 1.0 block
- Unit weight: 72 lbs
- Cube Count: 36 blocks
- Cube Weight (w/pallet): 3500 lbs

KEYSTONE® HARDSCAPES

TENCATE
Mirafi

Drainage

Mirafi® 140NL

Mirafi® 140NL is a nonwoven geotextile composed of polypropylene fibers, which are formed into a network such that the fibers retain their relative position. Mirafi® 140NL is inert to biological degradation and resists naturally encountered chemicals, alkalis, and acids.

Mechanical Properties	Test Method	Unit	Minimum Average Roll Value	
			MD	CD
Grab Tensile Strength	ASTM D 4632	kN (lbs)	0.4 (90)	0.4 (90)
Grab Tensile Elongation	ASTM D 4632	%	50	50
Trapezoid Tear Strength	ASTM D 4533	kN (lbs)	0.2 (40)	0.2 (40)
Mullen Burst Strength	ASTM D 3786	kPa (psi)	1205.6 (175)	
Puncture Strength[1]	ASTM D 4833	kN (lbs)	0.2 (55)	
CBR Puncture Strength	ASTM D 6241	kN (lbs)	1.1 (250)	
Apparent Opening Size (AOS)[2]	ASTM D 4751	mm (U.S. Sieve)	0.25 (60)	
Permittivity	ASTM D 4491	sec^{-1}	2.0	
Flow Rate	ASTM D 4491	$l/min/m^2$ ($gal/min/ft^2$)	5907.3 (145)	
UV Resistance (at 500 hours)	ASTM D 4355	% strength retained	70	

[1] ASTM D 4833 has been replaced with ASTM D 6241
[2] ASTM D 4751: AOS is a Maximum Opening Diameter Value

Physical Properties	Test Method	Unit	Typical Value	
Weight	ASTM D 5261	g/m^2 (oz/yd^2)	135.0 (4.0)	
Thickness	ASTM D 5199	mm (mils)	0.9 (35)	
Roll Dimensions (width x length)	--	m (ft)	3.8 x 110 (12.5 x 360)	4.5 x 110 (15 x 360)
Roll Area	--	m^2 (yd^2)	418 (500)	502 (600)
Estimated Roll Weight	--	kg (lb)	60 (133)	70 (160)

SGU 60

STRATAGRID® PRODUCT DATA SHEET

StrataGrid is a flexible, high-performance line of geogrid products used in soil reinforcement and other civil engineering applications. These geogrids are constructed using high tenacity polyester yarns utilizing a complex knitting process and polymeric coating to provide superior engineering properties. StrataGrid is engineered to be mechanically and chemically durable, in both the harsh construction installation phase and in aggressive soil environments.

		UNIT	SGU 60
MECHANICAL PROPERTIES			
Ultimate Tensile Strength (ASTM D 6637)	MD	kN/m (lbs/ft)	60 (4,111)
Creep Reduction Factor (at 20°c, 114 years design life)	MD	RF_{CR}	1.44
Creep Limited Strength	MD	kN/m (lbs/ft)	41.7 (2,855)
Partial Factor - Installation Damage (ASTM D 5818) In sand/silt/clay		RF_{ID}	1.10
Partial Factor - Environmental Effects (GRI-GG7, GRI-GG8) Environment, 3 < pH < 9		RF_{D}	1.10
Long Term Design Strength (LTDS) *sand/silt/clay	MD	kN/m (lbs/ft)	34.4 (2,359)
PHYSICAL PROPERTIES			
Roll dimensions (width x length)		m (ft)	1.9 x 88 / 3.8 x 88 / 5.7 x 88* / 3.8 x 438.9 (6.25 x 288 / 12.5 x 288 / 18.75 x 288* / 12.5 x 1,440) *made to order
Roll Area		sy	200 / 400 / 600 / 2,000
MOLECULAR PROPERTIES			
Molecular weight (GRI GG8, ASTM D4603)		g/mol	min. 25,000
Carboxyl end group (CEG) (GRI GG7, ASTM D7409)		mmol/kg	max. 30

* Values above reflect published ultimate values and are derived from Minimum Average Roll Values (MARV).
* Certain custom roll widths and lengths available upon request

geogrid.com
1-800-680-7750

Revised 08/25/2021

BOONE QUARRIES

Gradation Report

Collection Date -

Quarry Location - Boone Quarry - Columbia

Product - 1" Base

Formation -

Ledges -

Customer - Rosch Company

Sieve	% Passing
1 1/2"	
1"	100.0%
3/4"	93.0%
1/2"	76.0%
3/8"	65.0%
#4	50.0%
#8	39.0%
#16	32.0%
#30	26.0%
#50	21.0%
#100	17.0%
#200	14.5%

SHOP DRAWING / SUBMITTAL REVIEW

- ☐ No Exception Taken
- ☑ Exceptions Noted, Resubmittal Not Required
- ☐ Revise and Resubmit
- ☐ Rejected
- ☐ Reviewed for Information Only

DAVID MASON + ASSOCIATES
davidmason.com

Checking is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Any action shown is subject to the requirements of the plans and specifications. Contractor is responsible for: Dimensions which shall be confirmed and correlated at the job site, fabrication processes and techniques of the construction, coordination of his work with that of all other trades and the satisfactory performance of his work.

Reviewed By: M Davis

Date: 12/24/2024

BLOCK COLOR APPROVAL BY OWNER, SUBMIT A SAMPLE IF REQUESTED.

BOONE QUARRIES

Gradation Report

Collection Date -

Quarry Location - Boone Quarry - Columbia

Product - 2" Clean

Formation -

Ledges -

Customer - Rosch Company

Sieve	% Passing
2"	100.0%
1 1/2"	83.0%
1"	23.0%
3/4"	16.0%
1/2"	4.0%
3/8"	3.0%
#4	3.0%
#8	2.0%
#30	2.0%
#200	1.0%

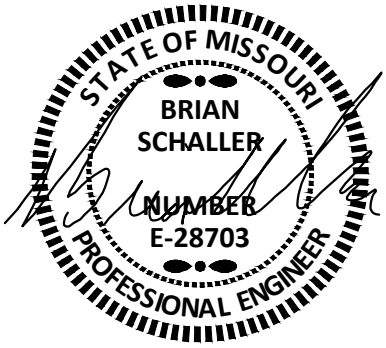
UMC THERMAL PLANT

COLUMBIA, MO

RETAINING WALL CALCULATIONS

ROSCH ENGINEERING
18390 WINGS CORPORATE DRIVE
CHESTERFIELD, MO 63005
PHONE: 636-519-7770
FAX: 636-532-7773

MO CERTIFICATE OF AUTHORITY #E-2012039663



12-3-2024

December 3, 2024

SHOP DRAWING / SUBMITTAL REVIEW

- ☐ No Exception Taken
- ☐ Exceptions Noted, Resubmittal Not Required
- ☐ Revise and Resubmit
- ☐ Rejected
- ☑ Reviewed for Information Only

DAVID MASON + ASSOCIATES
davidmason.com

Checking is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Any action shown is subject to the requirements of the plans and specifications. Contractor is responsible for: Dimensions which shall be confirmed and correlated at the job site, fabrication processes and techniques of the construction, coordination of his work with that of all other trades and the satisfactory performance of his work.

Reviewed By: M Davis

Date: 12/24/2024

SRWall (Version 4) Report

Project Identification

Project ID	: **24-0251**
Project Name	: **UMC Thermal Plant**
Owner	:
Client	:
Prepared By	: **AMR**
Company	: **ROSCH Engineering**
Address	:
Telephone	:
Section	:
Project File	: **Design Type 1 - 3-1 Backslope - 2'.prj**
Vendor Data File	:
Date and Time	: **11/07/2024 11:57:49**

Type of Structure	: **Gravity Wall**

Wall Geometry

Design Wall Height(ft)	: **2.00**
Embedment Wall Height(ft)	: **1.87**
Exposed Wall Design Height(ft)	: **0.13**
Number of Segmental Wall Units	: **3**
Wall Inclination(degrees)	: **8.46**

Grades

Top Slope(degrees)	: **18.43**

Uniform Distributed Surcharge

Live Load Surcharge(Psf)	: **25.00**
Dead Load Surcharge(Psf)	: **0.00**

Soil Data

Soil Zone	Description	Cohesion (c) (psf)	Friction Angle(Φ) (degrees)	Unit Weight (γ)(pcf)
Retained Soil	Drainage Rock	N/A	38.00	120.00
Leveling Pad Soil	Gravel	N/A	34.00	125.00
Foundation Soil	Lean Clay	50.00	25.00	120.00

Segmental Unit Data

Segmental Unit Name	: **Romanstone Brutus**
Cap Height (Inches)	: **4.00**
Unit Height (Hu)(Inches)	: **8.00**
Unit Width (Wu)(Inches)	: **12.00**
Unit Length (Inches)	: **18.00**
Setback (Inches)	: **1.19**
Weight (Infilled)(lb)	: **130.00**
Unit Weight (Infilled)(pcf)	: **130.00**
Center of Gravity(Inches)	: **6.00**

Unit-Unit Interface Properties

Minimum Shear Capacity(lb/ft)	Shear Friction Angle	Maximum Shear Capacity (lb/ft)
962.00	26.00	1950.00

Design Criteria For External Stability Analysis

FOS Sliding	: **1.50**
FOS Overturning	: **1.50**
FOS Bearing Capacity	: **2.00**

Design Criteria For Facing Stability Analysis

FOS Internal Shear	: **1.50**

Vertical Components

Vertical Components of Earth Pressures Used	: **No**

Cofficients of Earth Pressure and Failure Plane Orientation

Retained Soil(Static)(Ka)	**: 0.200**
Retained Soil(Static)(Kah Horizontal Component)	**: 0.174**
External Modified Back Slope(Bext)	**: 18.430**
Orientation of failure plane from horizontal(degrees) for External Stability	**: 54.652**

Result of External Stability Static Analysis

	Calculated	Design Criteria
FOS Sliding	2.21	> 1.50
FOS Overturning	3.88	> 1.50
FOS Bearing Capacity	23.17	> 2.00
Base Footing (B)(ft)	1.50	

Detailed Result of External Stability Analysis

	Calculated
Total Horizontal Force (lb/ft)	55.45
Total Vertical Force (lb/ft)	260.00
Sliding Resistance (lb/ft)	122.76
Driving Moment (lb-ft/ft)	40.15
Resisting Moment (lb-ft/ft)	155.78
Bearing Capacity (psf)	4335.36
Base Eccentricity (e)(ft.)	0.06
Eccentricity Ratio (e/Bf)(ft.)	0.04
Maximum Bearing Pressure (psf)	187.12

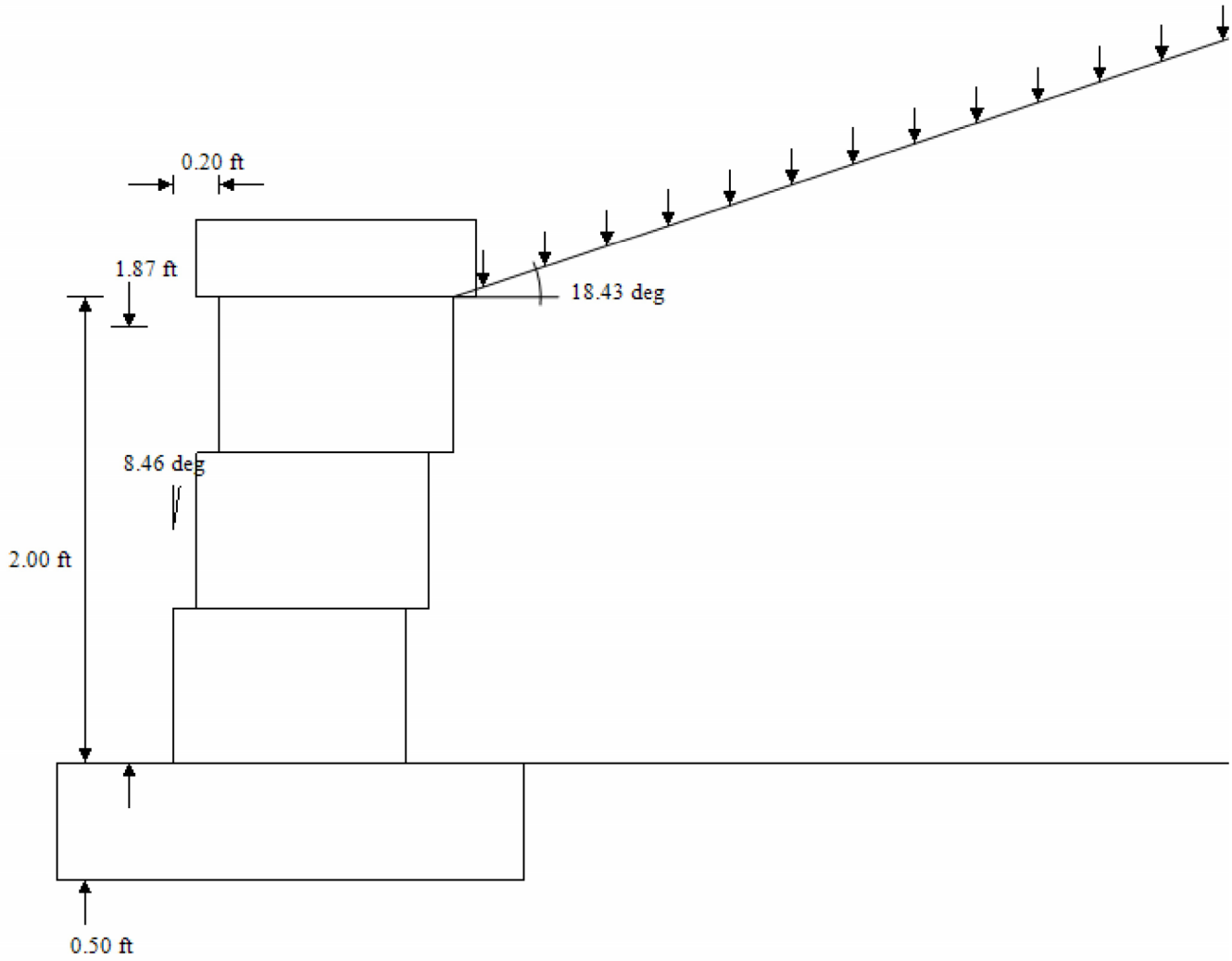
Results of Internal Stability Static Analysis

SRW Unit #	Heel Elev (ft)	FOS Shear >=1.50
3	1.33	121.22
2	0.67	39.10

Results of Internal Stability Analysis(Shear)

SRW Unit #	Heel Elev (ft)	Shear Load (lb/ft)	Shear Capacity (lb/ft)
3	1.33	8.28	1004.27
2	0.67	26.77	1046.54

Wall Geometry Layout



Project Identification

Project ID	: **24-0251**
Project Name	: **UMC Thermal Plant**
Owner	:
Client	:
Prepared By	: **AMR**
Company	: **ROSCH Engineering**
Address	:
Telephone	:
Section	:
Vendor Data File	:
Project File	: **Design Type 1 - 3-1 Backslope - 2'.prj**
Date and Time	: **11/07/2024 11:57:49**

SRWall (Version 4) Report

Project Identification

Project ID	: **24-0251**
Project Name	: **UMC Thermal Plant**
Owner	:
Client	:
Prepared By	: **AMR**
Company	: **ROSCH Engineering**
Address	:
Telephone	:
Section	:
Project File	: **Design Type 1 - 3-1 Backslope - 4'.prj**
Vendor Data File	:
Date and Time	: **11/07/2024 11:57:49**

Type of Structure	: **Reinforced Wall**

Wall Geometry

Design Wall Height(ft)	: **4.00**
Embedment Wall Height(ft)	: **1.87**
Exposed Wall Design Height(ft)	: **2.13**
Number of Segmental Wall Units	: **6**
Wall Inclination(degrees)	: **8.46**

Grades

Top Slope(degrees)	: **18.43**

Uniform Distributed Surcharge

Live Load Surcharge(Psf)	: **25.00**
Dead Load Surcharge(Psf)	: **0.00**

Soil Data

Soil Zone	Description	Cohesion (c) (psf)	Friction Angle(Φ) (degrees)	Unit Weight (γ)(pcf)
Reinforced Soil	Drainage Rock	N/A	38.00	105.00
Retained Soil	Lean Clay	N/A	25.00	120.00
Leveling Pad Soil	Gravel	N/A	34.00	125.00
Foundation Soil	Lean Clay	50.00	25.00	120.00

Segmental Unit Data

Segmental Unit Name	**: Romanstone Brutus**
Cap Height (Inches)	**: 4.00**
Unit Height (Hu)(Inches)	**: 8.00**
Unit Width (Wu)(Inches)	**: 12.00**
Unit Length (Inches)	**: 18.00**
Setback (Inches)	**: 1.19**
Weight (Infilled)(lb)	**: 130.00**
Unit Weight (Infilled)(pcf)	**: 130.00**
Center of Gravity(Inches)	**: 6.00**

Geosynthetic Reinforcement Type and Number

Supplier	Product Name	Number
	SF110	0
	SF20	0
	SF35	1
	SF55	0
	SF80	0

Geosynthetic Properties

Geosynthetic Product	Tult (lb/ft)	RFcr	RFd	RFid	LTDS (lb/ft)	Ci	Cds
SF110	10205.00	1.75	1.15	1.20	4225.67	0.90	0.90
SF20	1940.00	1.70	1.15	1.20	826.94	0.90	0.90
SF35	3435.00	1.70	1.15	1.20	1464.19	0.90	0.90
SF55	4670.00	1.68	1.15	1.20	2014.32	0.90	0.90
SF80	7400.00	1.75	1.15	1.20	3064.18	0.90	0.90

Unit-Unit Interface Properties

Minimum Shear Capacity(lb/ft)	Shear Friction Angle	Maximum Shear Capacity (lb/ft)
962.00	26.00	1950.00

Geosynthetic-SRW Unit Connection Strength properties

Geosynthetic Product	Minimum Conn. Capacity (lb/ft)	1st Inflection Point (lb/ft)		2nd Inflection Point (lb/ft)	
		Normal Load (lb/ft)	Connection Capacity (lb/ft)	Normal Load (lb/ft)	Max Connection Capacity(lb/ft)
SF110	1925.00	2983.00	3312.00	4772.00	3950.00
SF20	785.00	920.00	866.00	1380.00	916.00
SF35	1184.00	1296.00	1591.00	1944.00	1665.00
SF55	1506.00	1300.00	1900.00	1900.00	2070.00
SF80	1563.00	1900.00	2325.00	2600.00	2625.00

Geosynthetic-SRW Unit Shear Strength properties

Geosynthetic Product	Minimum Shear Capacity(lb/ft)	Shear Friction Angle	Maximum Shear Capacity (lb/ft)
SF110	962.00	26.00	1950.00
SF20	962.00	26.00	1950.00
SF35	962.00	26.00	1950.00
SF55	962.00	26.00	1950.00
SF80	962.00	26.00	1950.00

Design Criteria For External Stability Analysis

FOS Sliding	**: 1.50**
FOS Overturning	**: 2.00**
FOS Bearing Capacity	**: 2.00**
Base Geosynthetic ratio(L/H)	**: 0.60**
Reinforced Soil-Retained Soil Interface Friction Factor	**: 1.00**
Reinforced Soil-Retained Soil Interface Friction Angle (degrees)	**: 38.00**

Design Criteria For Internal Stability Analysis

FOS Tensile Overstress	**: 1.50**
FOS Pullout	**: 1.50**
Anchorage Length (ft) :	**: 1.00**
Wall-Retained Soil Interface Friction Factor	**: 0.67**
Wall-Retained Soil Interface Friction Angle(degrees)	**: 25.46**

Design Criteria For Facing Stability Analysis

FOS Geosynthetic-WallConnection	**: 1.50**
FOS Crest Toppling	**: 1.50**
Max. Reinforcement Spacing	**: 2.0**

Vertical Components

Vertical Components of Earth Pressures Used	**: No**

Cofficients of Earth Pressure and Failure Plane Orientation

Reinforcement Soil(Static)(Ka)	**: 0.200**
Reinforcement Soil(Static)(Kah Horizontal Component)	**: 0.191**
Internal Modified Back Slope(Bint)	**: 18.430**
Orientation of failure plane from horizontal(degrees) for Internal Stability	**: 54.652**
Retained Soil(Static)(Ka)	**: 0.426**
Retained Soil(Static)(Kah Horizontal Component)	**: 0.408**
External Modified Back Slope(Bext)	**: 18.430**
Orientation of failure plane from horizontal(degrees) for External Stability	**: 40.312**

Result of External Stability Static Analysis

	Calculated	Design Criteria
FOS Sliding	1.57	> 1.50
FOS Overturning	3.70	> 2.00
FOS Bearing Capacity	10.21	> 2.00
Base Reinforcement Length (L)(ft)	4.00	
Base Reinforcement Ratio (L/H)	1.00	> 0.60

Detailed Result of External Stability Analysis

	Calculated
Total Horizontal Force (lb/ft)	676.57
Total Vertical Force (lb/ft)	1845.67
Sliding Resistance (lb/ft)	1060.65
Driving Moment (lb-ft/ft)	1182.72
Resisting Moment (lb-ft/ft)	4372.07
Bearing Capacity (psf)	5683.95
Base Eccentricity (e)(ft.)	0.27
Eccentricity Ratio (e/L-2e)	0.08
Maximum Bearing Pressure (psf)	556.87

Results of Internal Stability Static Analysis

SRW Unit #	Geosynthetic Product	Elevation (ft)	Length (ft)	Anchor Length (ft)	FOS Overstress >=1.50	FOS Pullout >=1.50	FOS Slide >=1.50	Layer Spacing (ft) >=2.0
4	SF35	2.00	4.00	1.88	8.15	3.99	6.36	OK

Detailed Results of Internal Stability Analysis

SRW Unit #	Geosynthetic Product	Elevation (ft)	Length (ft)	Anchor Length (ft)	LTDS (lb/ft)	Tensile Load (lb/ft)	Pullout capacity (lb/ft)	Sliding Force (lb/ft)	Sliding Capacity (lb/ft)
4	SF35	2.00	4.00	1.88	1464.19	179.72	717.88	259.24	1648.29

Results of Facing Stability Static Analysis

SRW Unit #	Heel Elev (ft)	Geosynthetic Product	FOS Crest Toppling >=1.50	FOS Connection >=1.50
4	2.00	SF35	4.29	7.04

Results of Facing Stability Analysis(Moment & Connection)

SRW Unit #	Heel Elev (ft)	Geosynthetic Product	Drive Moment (lb-ft/ft)	Resist Moment (lb-ft/ft)	Connection Load (lb/ft)	Connection Capacity (lb/ft)
4	2.00	SF35	36.33	155.78	179.72	1265.65

Internal Compound Stability Result

SRW Units	Factor Of Safety	ΣFr (lb/ft)	ΣVu Or ΣConn (lb/ft)	ΣFs (lb/ft)	ΣFgrid (lb/ft)	ΣDynF (lb/ft)	ΣWt (lb/ft)	ΣQl (lb/ft)	ΣQd (lb/ft)
1	1.799	2263	667	1629	0	0	3632	214	0
2	1.996	1474	896	1189	4	0	2347	211	0
3	2.607	1495	1125	1018	33	0	2339	220	0
4	2.994	1211	1089	768	0	0	1895	218	0
5	3.399	1011	949	577	0	0	1595	215	0
6	3.540	709	633	379	0	0	1139	213	0

Basic Internal Compound Stability Static Result

Lowest FOS : **1.799**

Critical Failure Plane Location -

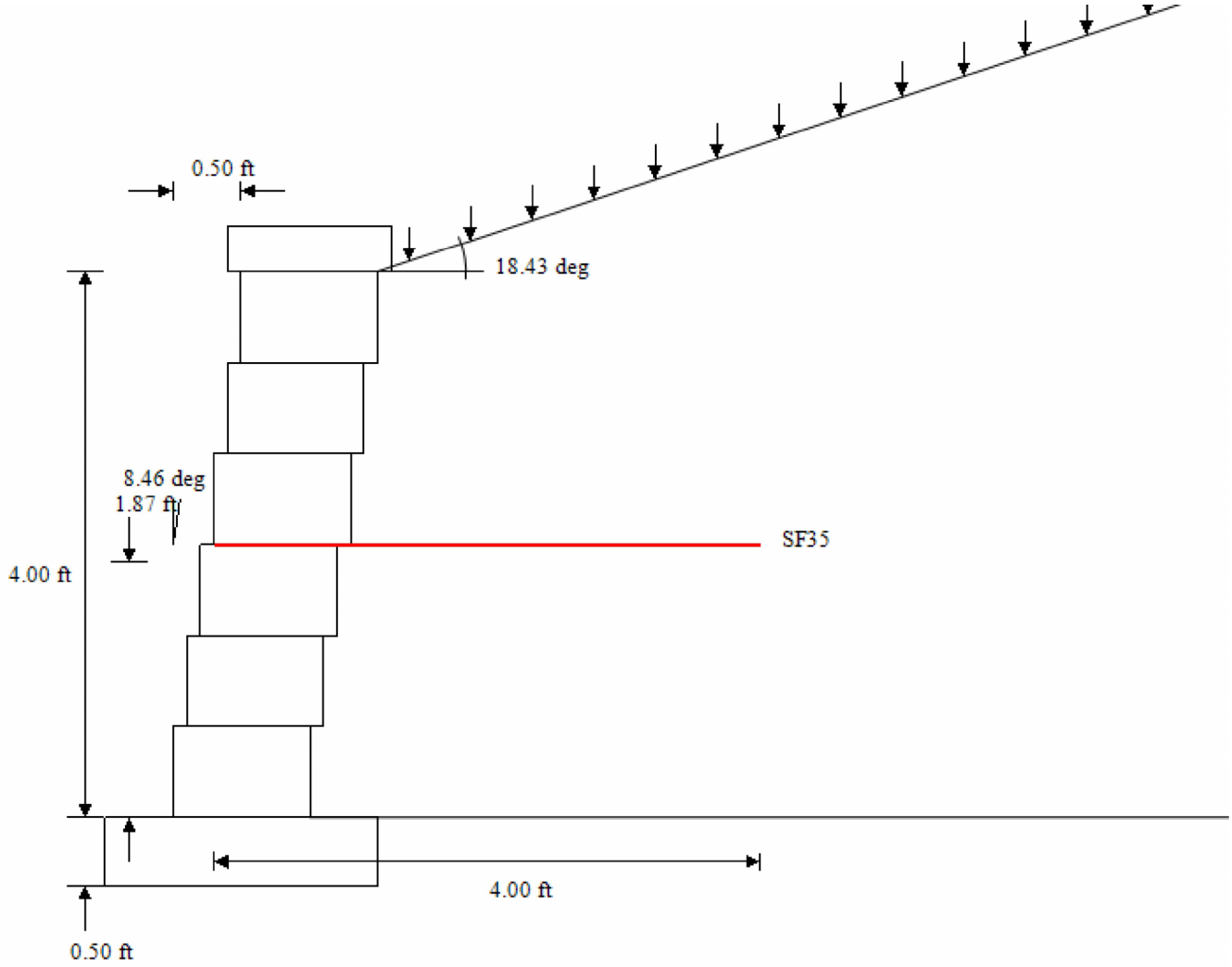
Height of Exit at Wall Face

SRW Unit : **# 1**

Elevation : **0.00 ft**

Distance to Entrance at Top Grade : **9.00 ft**

Wall Reinforcement Layout



Project Identification

Project ID	: **24-0251**
Project Name	: **UMC Thermal Plant**
Owner	:
Client	:
Prepared By	: **AMR**
Company	: **ROSCH Engineering**
Address	:
Telephone	:
Section	:
Vendor Data File	:
Project File	: **Design Type 1 - 3-1 Backslope - 4'.prj**
Date and Time	: **11/07/2024 11:57:49**

SRWall (Version 4) Report

Project Identification

Project ID	: **24-0251**
Project Name	: **UMC Thermal Plant**
Owner	:
Client	:
Prepared By	: **AMR**
Company	: **ROSCH Engineering**
Address	:
Telephone	:
Section	:
Project File	: **Design Type 1 - 3-1 Backslope - 4.67'.prj**
Vendor Data File	:
Date and Time	: **11/07/2024 11:57:49**

Type of Structure	: **Reinforced Wall**

Wall Geometry

Design Wall Height(ft)	: **4.67**
Embedment Wall Height(ft)	: **1.87**
Exposed Wall Design Height(ft)	: **2.80**
Number of Segmental Wall Units	: **7**
Wall Inclination(degrees)	: **8.46**

Grades

Top Slope(degrees)	: **18.43**

Uniform Distributed Surcharge

Live Load Surcharge(Psf)	: **25.00**
Dead Load Surcharge(Psf)	: **0.00**

Soil Data

Soil Zone	Description	Cohesion (c) (psf)	Friction Angle(Φ) (degrees)	Unit Weight (γ)(pcf)
Reinforced Soil	Drainage Rock	N/A	38.00	105.00
Retained Soil	Lean Clay	N/A	25.00	120.00
Leveling Pad Soil	Gravel	N/A	34.00	125.00
Foundation Soil	Lean Clay	50.00	25.00	120.00

Segmental Unit Data

Segmental Unit Name	**: Romanstone Brutus**
Cap Height (Inches)	**: 4.00**
Unit Height (Hu)(Inches)	**: 8.00**
Unit Width (Wu)(Inches)	**: 12.00**
Unit Length (Inches)	**: 18.00**
Setback (Inches)	**: 1.19**
Weight (Infilled)(lb)	**: 130.00**
Unit Weight (Infilled)(pcf)	**: 130.00**
Center of Gravity(Inches)	**: 6.00**

Geosynthetic Reinforcement Type and Number

Supplier	Product Name	Number
	SF110	0
	SF20	0
	SF35	2
	SF55	0
	SF80	0

Geosynthetic Properties

Geosynthetic Product	Tult (lb/ft)	RFcr	RFd	RFid	LTDS (lb/ft)	Ci	Cds
SF110	10205.00	1.75	1.15	1.20	4225.67	0.90	0.90
SF20	1940.00	1.70	1.15	1.20	826.94	0.90	0.90
SF35	3435.00	1.70	1.15	1.20	1464.19	0.90	0.90
SF55	4670.00	1.68	1.15	1.20	2014.32	0.90	0.90
SF80	7400.00	1.75	1.15	1.20	3064.18	0.90	0.90

Unit-Unit Interface Properties

Minimum Shear Capacity(lb/ft)	Shear Friction Angle	Maximum Shear Capacity (lb/ft)
962.00	26.00	1950.00

Geosynthetic-SRW Unit Connection Strength properties

Geosynthetic Product	Minimum Conn. Capacity (lb/ft)	1st Inflection Point (lb/ft)		2nd Inflection Point (lb/ft)	
		Normal Load (lb/ft)	Connection Capacity (lb/ft)	Normal Load (lb/ft)	Max Connection Capacity(lb/ft)
SF110	1925.00	2983.00	3312.00	4772.00	3950.00
SF20	785.00	920.00	866.00	1380.00	916.00
SF35	1184.00	1296.00	1591.00	1944.00	1665.00
SF55	1506.00	1300.00	1900.00	1900.00	2070.00
SF80	1563.00	1900.00	2325.00	2600.00	2625.00

Geosynthetic-SRW Unit Shear Strength properties

Geosynthetic Product	Minimum Shear Capacity(lb/ft)	Shear Friction Angle	Maximum Shear Capacity (lb/ft)
SF110	962.00	26.00	1950.00
SF20	962.00	26.00	1950.00
SF35	962.00	26.00	1950.00
SF55	962.00	26.00	1950.00
SF80	962.00	26.00	1950.00

Design Criteria For External Stability Analysis

FOS Sliding	**: 1.50**
FOS Overturning	**: 2.00**
FOS Bearing Capacity	**: 2.00**
Base Geosynthetic ratio(L/H)	**: 0.60**
Reinforced Soil-Retained Soil Interface Friction Factor	**: 1.00**
Reinforced Soil-Retained Soil Interface Friction Angle (degrees)	**: 38.00**

Design Criteria For Internal Stability Analysis

FOS Tensile Overstress	**: 1.50**
FOS Pullout	**: 1.50**
Anchorage Length (ft) :	**: 1.00**
Wall-Retained Soil Interface Friction Factor	**: 0.67**
Wall-Retained Soil Interface Friction Angle(degrees)	**: 25.46**

Design Criteria For Facing Stability Analysis

FOS Geosynthetic-WallConnection	**: 1.50**
FOS Crest Toppling	**: 1.50**
Max. Reinforcement Spacing	**: 2.0**

Vertical Components

Vertical Components of Earth Pressures Used	**: No**

Cofficients of Earth Pressure and Failure Plane Orientation

Reinforcement Soil(Static)(Ka)	**: 0.200**
Reinforcement Soil(Static)(Kah Horizontal Component)	**: 0.191**
Internal Modified Back Slope(Bint)	**: 18.430**
Orientation of failure plane from horizontal(degrees) for Internal Stability	**: 54.652**
Retained Soil(Static)(Ka)	**: 0.426**
Retained Soil(Static)(Kah Horizontal Component)	**: 0.408**
External Modified Back Slope(Bext)	**: 18.430**
Orientation of failure plane from horizontal(degrees) for External Stability	**: 40.312**

Result of External Stability Static Analysis

	Calculated	Design Criteria
FOS Sliding	1.59	> 1.50
FOS Overturning	4.04	> 2.00
FOS Bearing Capacity	9.93	> 2.00
Base Reinforcement Length (L)(ft)	5.00	
Base Reinforcement Ratio (L/H)	1.07	> 0.60

Detailed Result of External Stability Analysis

	Calculated
Total Horizontal Force (lb/ft)	964.02
Total Vertical Force (lb/ft)	2744.52
Sliding Resistance (lb/ft)	1529.79
Driving Moment (lb-ft/ft)	2012.90
Resisting Moment (lb-ft/ft)	8138.22
Bearing Capacity (psf)	6341.51
Base Eccentricity (e)(ft.)	0.27
Eccentricity Ratio (e/L-2e)	0.06
Maximum Bearing Pressure (psf)	638.43

Results of Internal Stability Static Analysis

SRW Unit #	Geosynthetic Product	Elevation (ft)	Length (ft)	Anchor Length (ft)	FOS Overstress >=1.50	FOS Pullout >=1.50	FOS Slide >=1.50	Layer Spacing (ft) >=2.0
5	SF35	2.67	5.00	2.50	14.02	9.96	5.94	OK
2	SF35	0.67	5.00	3.62	10.73	17.76	3.38	OK

Detailed Results of Internal Stability Analysis

SRW Unit #	Geosynthetic Product	Elevation (ft)	Length (ft)	Anchor Length (ft)	LTDS (lb/ft)	Tensile Load (lb/ft)	Pullout capacity (lb/ft)	Sliding Force (lb/ft)	Sliding Capacity (lb/ft)
5	SF35	2.67	5.00	2.50	1464.19	104.46	1040.01	317.65	1885.36
2	SF35	0.67	5.00	3.62	1464.19	136.44	2423.14	769.01	2602.82

Results of Facing Stability Static Analysis

SRW Unit #	Heel Elev (ft)	Geosynthetic Product	FOS Crest Toppling >=1.50	FOS Connection >=1.50
5	2.67	SF35	4.30	12.11
2	0.67	SF35		9.87

Results of Facing Stability Analysis(Moment & Connection)

SRW Unit #	Heel Elev (ft)	Geosynthetic Product	Drive Moment (lb-ft/ft)	Resist Moment (lb-ft/ft)	Connection Load (lb/ft)	Connection Capacity (lb/ft)
5	2.67	SF35	36.16	155.46	104.46	1265.52
2	0.67	SF35			136.44	1347.17

Internal Compound Stability Result

SRW Units	Factor Of Safety	ΣFr (lb/ft)	ΣVu Or ΣConn (lb/ft)	ΣFs (lb/ft)	ΣFgrid (lb/ft)	ΣDynF (lb/ft)	ΣWt (lb/ft)	ΣQl (lb/ft)	ΣQd (lb/ft)
1	1.997	3252	1258	2287	57	0	5158	261	0
2	1.962	2225	1216	1754	0	0	3562	259	0
3	2.182	2051	1173	1479	2	0	3266	270	0
4	2.497	2054	1131	1280	11	0	3251	268	0
5	2.789	1530	1089	939	0	0	2427	265	0
6	3.086	1303	949	730	0	0	2081	263	0
7	3.212	962	633	496	0	0	1517	260	0

Basic Internal Compound Stability Static Result

Lowest FOS : **1.962**

Critical Failure Plane Location -

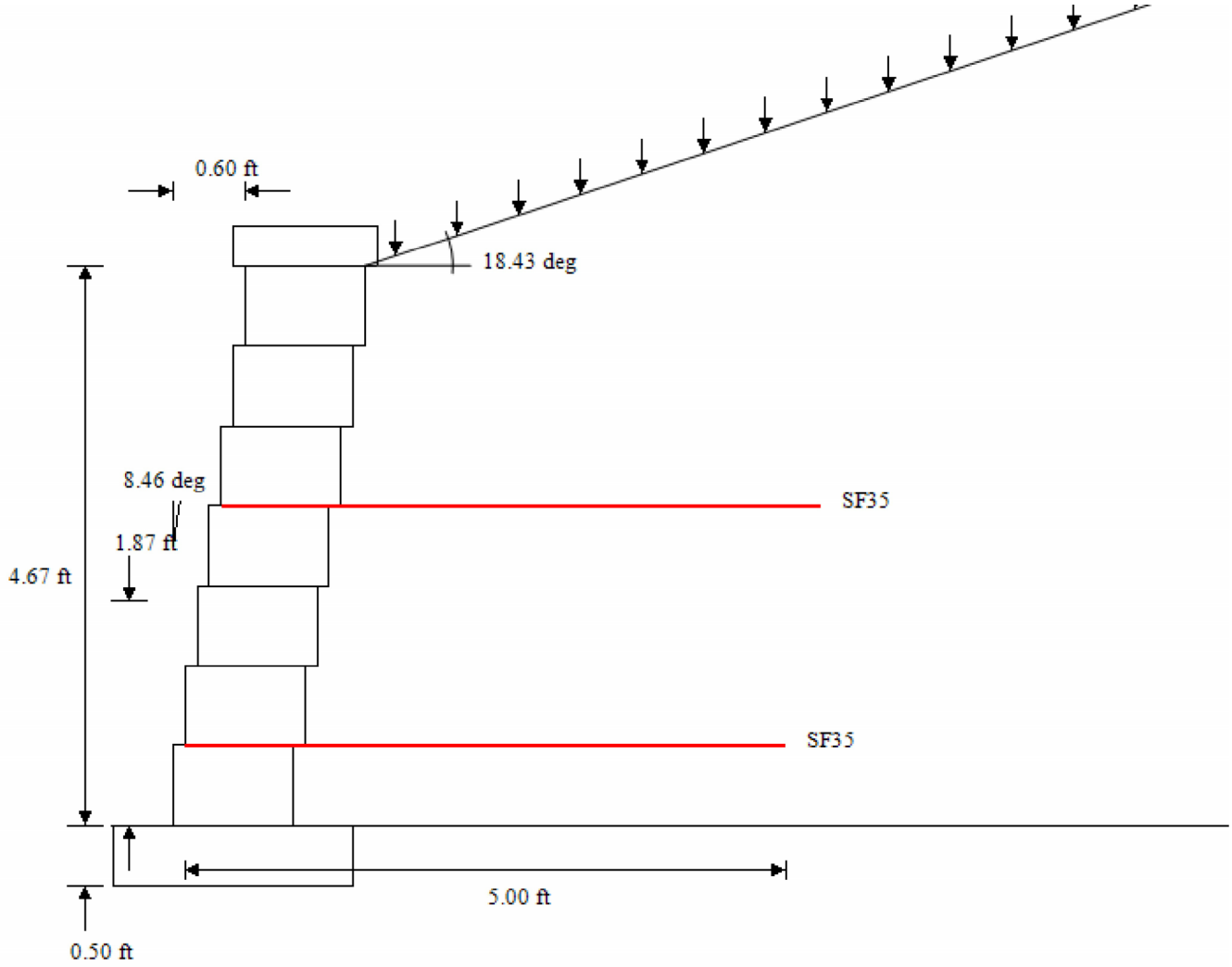
Height of Exit at Wall Face

SRW Unit : **# 2**

Elevation : **0.67 ft**

Distance to Entrance at Top Grade : **11.00 ft**

Wall Reinforcement Layout



Project Identification

Project ID	: **24-0251**
Project Name	: **UMC Thermal Plant**
Owner	:
Client	:
Prepared By	: **AMR**
Company	: **ROSCH Engineering**
Address	:
Telephone	:
Section	:
Vendor Data File	:
Project File	: **Design Type 1 - 3-1 Backslope - 4.67'.prj**
Date and Time	: **11/07/2024 11:57:49**

SRWall (Version 4) Report

Project Identification

Project ID	: **24-0251**
Project Name	: **UMC Thermal Plant**
Owner	:
Client	:
Prepared By	: **AMR**
Company	: **ROSCH Engineering**
Address	:
Telephone	:
Section	:
Project File	: **Design Type 1 - 3-1 Backslope - 5.33'.prj**
Vendor Data File	:
Date and Time	: **11/07/2024 11:57:49**

Type of Structure	: **Reinforced Wall**

Wall Geometry

Design Wall Height(ft)	: **5.33**
Embedment Wall Height(ft)	: **1.87**
Exposed Wall Design Height(ft)	: **3.46**
Number of Segmental Wall Units	: **8**
Wall Inclination(degrees)	: **8.46**

Grades

Top Slope(degrees)	: **18.43**

Uniform Distributed Surcharge

Live Load Surcharge(Psf)	: **25.00**
Dead Load Surcharge(Psf)	: **0.00**

Soil Data

Soil Zone	Description	Cohesion (c) (psf)	Friction Angle(Φ) (degrees)	Unit Weight (γ)(pcf)
Reinforced Soil	Drainage Rock	N/A	38.00	105.00
Retained Soil	Lean Clay	N/A	25.00	120.00
Leveling Pad Soil	Gravel	N/A	34.00	125.00
Foundation Soil	Lean Clay	50.00	25.00	120.00

Segmental Unit Data

Segmental Unit Name	**: Romanstone Brutus**
Cap Height (Inches)	**: 4.00**
Unit Height (Hu)(Inches)	**: 8.00**
Unit Width (Wu)(Inches)	**: 12.00**
Unit Length (Inches)	**: 18.00**
Setback (Inches)	**: 1.19**
Weight (Infilled)(lb)	**: 130.00**
Unit Weight (Infilled)(pcf)	**: 130.00**
Center of Gravity(Inches)	**: 6.00**

Geosynthetic Reinforcement Type and Number

Supplier	Product Name	Number
	SF110	0
	SF20	0
	SF35	2
	SF55	0
	SF80	0

Geosynthetic Properties

Geosynthetic Product	Tult (lb/ft)	RFcr	RFd	RFid	LTDS (lb/ft)	Ci	Cds
SF110	10205.00	1.75	1.15	1.20	4225.67	0.90	0.90
SF20	1940.00	1.70	1.15	1.20	826.94	0.90	0.90
SF35	3435.00	1.70	1.15	1.20	1464.19	0.90	0.90
SF55	4670.00	1.68	1.15	1.20	2014.32	0.90	0.90
SF80	7400.00	1.75	1.15	1.20	3064.18	0.90	0.90

Unit-Unit Interface Properties

Minimum Shear Capacity(lb/ft)	Shear Friction Angle	Maximum Shear Capacity (lb/ft)
962.00	26.00	1950.00

Geosynthetic-SRW Unit Connection Strength properties

Geosynthetic Product	Minimum Conn. Capacity (lb/ft)	1st Inflection Point (lb/ft)		2nd Inflection Point (lb/ft)	
		Normal Load (lb/ft)	Connection Capacity (lb/ft)	Normal Load (lb/ft)	Max Connection Capacity(lb/ft)
SF110	1925.00	2983.00	3312.00	4772.00	3950.00
SF20	785.00	920.00	866.00	1380.00	916.00
SF35	1184.00	1296.00	1591.00	1944.00	1665.00
SF55	1506.00	1300.00	1900.00	1900.00	2070.00
SF80	1563.00	1900.00	2325.00	2600.00	2625.00

Geosynthetic-SRW Unit Shear Strength properties

Geosynthetic Product	Minimum Shear Capacity(lb/ft)	Shear Friction Angle	Maximum Shear Capacity (lb/ft)
SF110	962.00	26.00	1950.00
SF20	962.00	26.00	1950.00
SF35	962.00	26.00	1950.00
SF55	962.00	26.00	1950.00
SF80	962.00	26.00	1950.00

Design Criteria For External Stability Analysis

FOS Sliding	**: 1.50**
FOS Overturning	**: 2.00**
FOS Bearing Capacity	**: 2.00**
Base Geosynthetic ratio(L/H)	**: 0.60**
Reinforced Soil-Retained Soil Interface Friction Factor	**: 1.00**
Reinforced Soil-Retained Soil Interface Friction Angle (degrees)	**: 38.00**

Design Criteria For Internal Stability Analysis

FOS Tensile Overstress	**: 1.50**
FOS Pullout	**: 1.50**
Anchorage Length (ft) :	**: 1.00**
Wall-Retained Soil Interface Friction Factor	**: 0.67**
Wall-Retained Soil Interface Friction Angle(degrees)	**: 25.46**

Design Criteria For Facing Stability Analysis

FOS Geosynthetic-WallConnection	**: 1.50**
FOS Crest Toppling	**: 1.50**
Max. Reinforcement Spacing	**: 2.0**

Vertical Components

Vertical Components of Earth Pressures Used	**: No**

Cofficients of Earth Pressure and Failure Plane Orientation

Reinforcement Soil(Static)(Ka)	**: 0.200**
Reinforcement Soil(Static)(Kah Horizontal Component)	**: 0.191**
Internal Modified Back Slope(Bint)	**: 18.430**
Orientation of failure plane from horizontal(degrees) for Internal Stability	**: 54.652**
Retained Soil(Static)(Ka)	**: 0.426**
Retained Soil(Static)(Kah Horizontal Component)	**: 0.408**
External Modified Back Slope(Bext)	**: 18.430**
Orientation of failure plane from horizontal(degrees) for External Stability	**: 40.312**

Result of External Stability Static Analysis

	Calculated	Design Criteria
FOS Sliding	1.52	> 1.50
FOS Overturning	3.85	> 2.00
FOS Bearing Capacity	8.98	> 2.00
Base Reinforcement Length (L)(ft)	5.50	
Base Reinforcement Ratio (L/H)	1.03	> 0.60

Detailed Result of External Stability Analysis

	Calculated
Total Horizontal Force (lb/ft)	1240.27
Total Vertical Force (lb/ft)	3452.75
Sliding Resistance (lb/ft)	1885.04
Driving Moment (lb-ft/ft)	2938.44
Resisting Moment (lb-ft/ft)	11325.73
Bearing Capacity (psf)	6599.04
Base Eccentricity (e)(ft.)	0.32
Eccentricity Ratio (e/L-2e)	0.07
Maximum Bearing Pressure (psf)	735.05

Results of Internal Stability Static Analysis

SRW Unit #	Geosynthetic Product	Elevation (ft)	Length (ft)	Anchor Length (ft)	FOS Overstress >=1.50	FOS Pullout >=1.50	FOS Slide >=1.50	Layer Spacing (ft) >=2.0
6	SF35	3.33	5.50	2.63	13.96	10.99	5.75	OK
3	SF35	1.33	5.50	3.75	7.10	12.59	3.43	OK

Detailed Results of Internal Stability Analysis

SRW Unit #	Geosynthetic Product	Elevation (ft)	Length (ft)	Anchor Length (ft)	LTDS (lb/ft)	Tensile Load (lb/ft)	Pullout capacity (lb/ft)	Sliding Force (lb/ft)	Sliding Capacity (lb/ft)
6	SF35	3.33	5.50	2.63	1464.19	104.89	1152.86	350.62	2016.71
3	SF35	1.33	5.50	3.75	1464.19	206.11	2593.95	819.80	2808.01

Results of Facing Stability Static Analysis

SRW Unit #	Heel Elev (ft)	Geosynthetic Product	FOS Crest Toppling >=1.50	FOS Connection >=1.50
6	3.33	SF35	4.28	12.07
3	1.33	SF35		6.54

Results of Facing Stability Analysis(Moment & Connection)

SRW Unit #	Heel Elev (ft)	Geosynthetic Product	Drive Moment (lb-ft/ft)	Resist Moment (lb-ft/ft)	Connection Load (lb/ft)	Connection Capacity (lb/ft)
6	3.33	SF35	36.49	156.11	104.89	1265.79
3	1.33	SF35			206.11	1347.44

Internal Compound Stability Result

SRW Units	Factor Of Safety	ΣFr (lb/ft)	ΣVu Or ΣConn (lb/ft)	ΣFs (lb/ft)	ΣFgrid (lb/ft)	ΣDynF (lb/ft)	ΣWt (lb/ft)	ΣQl (lb/ft)	ΣQd (lb/ft)
1	1.789	4076	1141	2916	0	0	6555	293	0
2	2.031	3652	1258	2513	194	0	5806	291	0
3	1.936	2415	1216	1875	0	0	3882	303	0
4	2.168	2495	1173	1692	0	0	3994	301	0
5	2.469	2336	1131	1431	65	0	3717	298	0
6	2.685	1916	1089	1119	0	0	3060	296	0
7	2.934	1506	949	837	0	0	2423	293	0
8	2.958	1104	633	587	0	0	1807	291	0

Basic Internal Compound Stability Static Result

Lowest FOS : **1.789**

Critical Failure Plane Location -

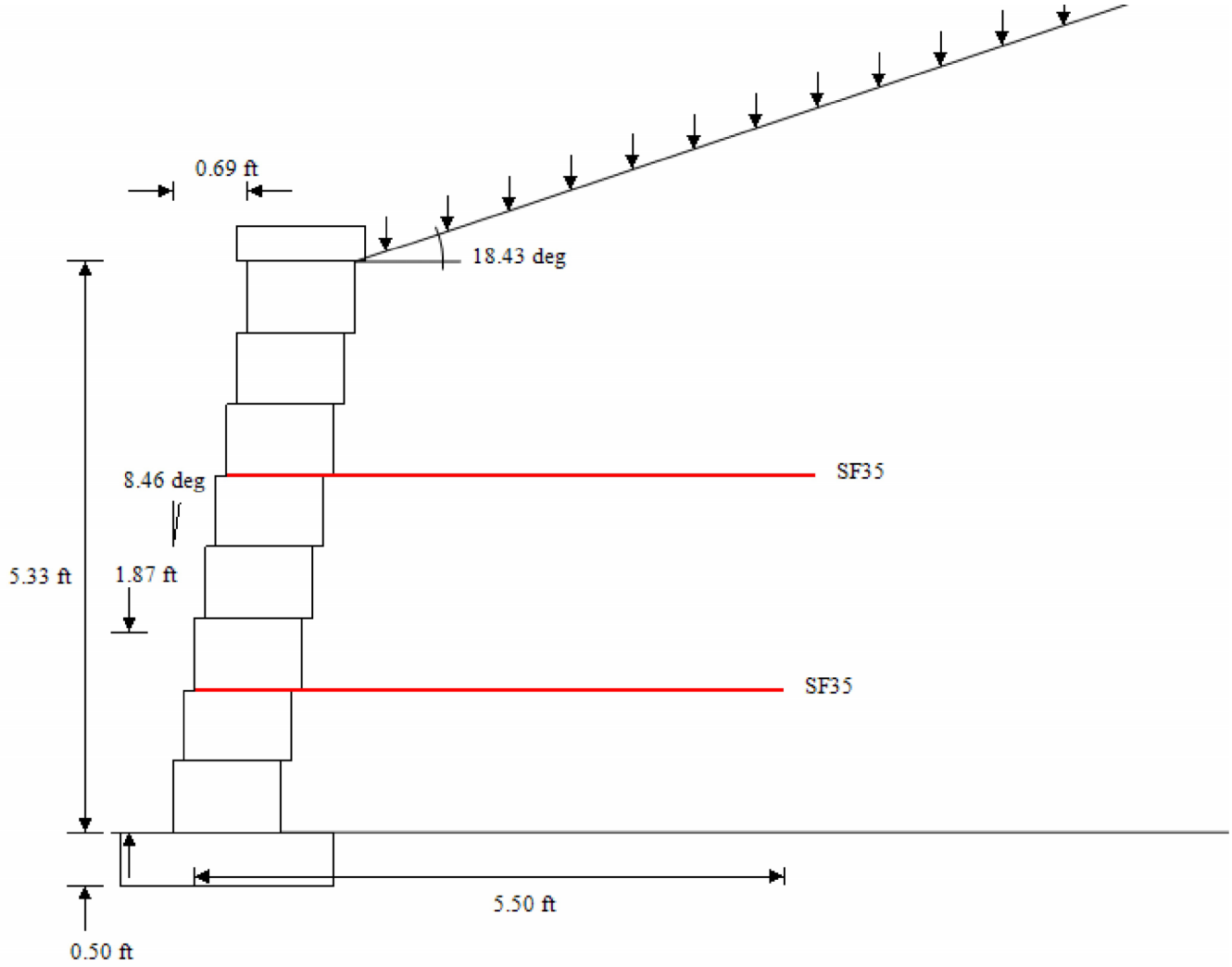
Height of Exit at Wall Face

SRW Unit : **# 1**

Elevation : **0.00 ft**

Distance to Entrance at Top Grade : **12.33 ft**

Wall Reinforcement Layout



Project Identification

Project ID	: **24-0251**
Project Name	: **UMC Thermal Plant**
Owner	:
Client	:
Prepared By	: **AMR**
Company	: **ROSCH Engineering**
Address	:
Telephone	:
Section	:
Vendor Data File	:
Project File	: **Design Type 1 - 3-1 Backslope - 5.33'.prj**
Date and Time	: **11/07/2024 11:57:49**

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